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FIRST LINES

S.J. 1832.

OF

ZOOLOGY,

BY

QUESTION AND ANSWER,

FOR THE USE OF THE YOUNG.

BIBLIOTHECA BODLEIANA

IN SEVEN PARTS.

Part I.—Mammalia.
Part II.—Birds.
Part III.—Fishes.
Part IV.—Reptiles.
Part V.—Insects.
Part VI.—Mollusca.
Part VII.—Crustacea,
etc. etc.

By ROBERT MUDIE.

LONDON:
WHITTAKER, TREACHER, AND CO.,
AVE-MARIA LANE.

1831.

170

LONDON:
HENRY BAYLIS, JOHNSON'S-COURT, FLEET-STREET.

NOTICE.

Works on Natural History for the use of young persons, are but too commonly faulty in more respects than one. They consist of mere scraps of description, generally exaggerated, and of little use if they were true; or they present the mere technicalities of an artificial system, in an unknown tongue, and thus make the real knowledge of the subject appear twice as formidable as it actually is, by adding an unexplained name to an undescribed reality.

In this little work I have attempted to avoid both these errors, and tried to blend some science with some description; but the object has all along been to inculcate principles, rather than to enter into details. The system of a work which, in so small a compass, touches upon so many subjects, is not a matter for severe criticism. Indeed, there is no one system, in any of the departments of Zoolo or indeed in any branch of Natural History, v which one who really understands the subject

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CATECHISM OF ZOOLOGY.

PART I.

MAMMALIA.

CHAPTER I.

INTRODUCTION.

Q. WHAT do you mean by the *Mammalia?*

A. The literal meaning is, "animals which give suck to their young," and of course bring them forth alive.*

Q. Do they get any other name?

A. With a few exceptions they are what are, in common language, termed "beasts," and also "quadrupeds," or four-footed creatures.

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* For a full account of animals generally, the pupil may be referred to the translation of "CUVIER'S ANIMAL KINGDOM," and for those that more exclusively inhabit Britain, to "The British Naturalist." The former is a complete system of animated Nature for all classes; the latter, sketches and explanations of natural subjects, without any formality of system, and therefore peculiarly fitted for the young.

Q. Would not *quadrupeds* be a better name for the whole class?

A. The substitution of quadrupeds for mammalia would include two animals, which, while they have more of the characters of the mammalia than of any other class, do not seem to suckle their young; but it would not apply so well to man, in whom two only of the extremities are feet, or to those mammalia that inhabit the water, and have their feet formed into paws adapted for swimming.

Q. What are the distinguishing characters of the mammalia?

A. They all have bones and flesh, and blood which is red and warm, and circulates; they all breathe atmospheric air, by which a portion of the waste of the system is discharged or separated in charcoal, which charcoal unites with the oxygen of the air, and forms carbonic acid.*

Q. Is the waste which is thus given out by animals of any use in Nature?

A. It forms part of the food of plants. Being heavier than atmospheric air, it falls to the ground, and fills the openings of the soil, in which the roots of plants are contained.

Q. How is the blood of the mammalia brought into contact with the air?

A. By means of the circulating system, which consists of two sets of tubes or vessels: one set (the *arteries*) originating in the heart, and branching out to all parts of the body, until the continuations become so small that they are not perceptible to the eye; and the other set (the *veins*) commencing at the extremities of these, uniting and becoming larger, and ultimately ending at the heart.

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* See Catechism of Chemistry.

Q. But how does that bring the blood into contact with the air?

A. The circulation toward all the parts of the body which has been mentioned does not perform that operation. The blood that is sent out from the heart nourishes all the parts of the body; and that which returns carries with it the superfluous charcoal, which is to be discharged by another operation.

Q. Is there any difference apparent in the blood as flowing from the heart and as returning to it?

A. Yes: the blood which is sent out from the heart by the arteries is of a bright red colour, and that which returns by the veins is dark.

Q. Is it darkened by charcoal?

A. We do not know that; we only know that when it comes into contact with the air, it gives out a portion of charcoal, and becomes bright red.

Q. How is the contact with the air accomplished?

A. In the mammalia, and also in birds, the air which is drawn in from the nostrils through the trachea, or windpipe, is received into the lungs, which are organs consisting of a number of cells or cavities, which all open into the windpipe, receive the air from that, when breath is drawn in, and expel it by the same passage, after it has been in contact with the blood.

Q. How is the blood brought to the lungs?

A. There is a scond set of circulating vessel that purpose, which, like the others, begin at the heart, spread themselves all over the lungs, and are there connected with veins which return the blood back again to the heart.

Q. Then there is a double circulation of the blood?

A. Yes; there is a *general* or systematic circulation, by which the body is nourished, the waste supplied, and substances that have become unfit for the purposes of life, in part removed; and there is a *pulmonary* circulation, by which the blood is purified in the lungs so as to be made fit for these purposes.

Q. How is that accomplished?

A. The heart is double; and consists of four cavities, two of which (the ventricles) are formed of strong muscular* fibres, which contract or draw them together with great force; the other two (the auricles) are less firm and muscular, and each of them opens into one of the ventricles. Each ventricle, with its auricle, is divided from the other by a strong partition, so that there is no communication between the pair on the one side, and that on the other.

Q. Are the arteries and veins connected with these?

A. Yes; the chief arteries of the two circulations have their origin in the two ventricles, while the principal veins that return the blood from those circulations have their terminations in the opposite auricles; so that the blood that returns from the general circulation is sent to the lungs, and that which returns from the lungs is sent to the general circulation. The contractions of the heart drive the respective currents of the blood into the two great arterial branches, and the expansions receive the returning currents from the great veins through the auricles; and there are valves that open to let the currents move in the proper directions, but which would close and stop those currents, if any thing should tend to throw them the other way.

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* See Catechism of Anatomy.

Q. I can understand, from what you have said, that this circulation is put in motion by the beats or pulses of the heart, and that the blood, as it comes from each of the two branches of the circulation, is sent to the other one; but I cannot yet see how it can come in contact with the air in the cells of the lungs, without escaping into those cells?

A. The mechanism by which that is effected is very delicate. The vessels in the cells of the lungs are remarkably small and delicate, and have very minute pores or openings, by means of which the air acts, at the same time that they are too small for permitting the particles of the blood to escape.

Q. Then the blood consists of particles?

A. It does: they are very small; their size differs in the different mammalia; but in man it would take about eight thousand millions of them to make a round ball an inch in diameter.

Q. And are the particles of air smaller than that?

A. They are so very minute that their magnitude cannot be ascertained, though they also must have some magnitude, as various substances can be made air-tight.

Q. Are there any other changes produced through the unison of carbon with the oxygen of the air?

A. Yes; the blood becomes less heavy and warmer. The action of the air seems to be more immediately necessary for the life and health of the mammalia (and also of birds) than anything else; so much so that in all languages *breath* and *life* are words that have nearly the same import. If the operation of breathing be stopped for even a very short time, the animals die.

Q. What are some of the other characters of the mammalia?

A. They all have a skeleton or framework of bones, which is composed of cartilage or gristle, and salts of lime; and their cavities, which in birds are often filled with air, contain oil or marrow, in different degrees of consistency.

Q. What is the prevailing form of the framework of bones?

A. The connecting or central part of it is the spine or back-bone; to the one extremity of which the head or skull is united, and the other, in most species, terminates in a tail. The head and spine contain the brain, and its continuation the spinal marrow, from which the nerves (the organs of motion and sensation) are given out; and the head also supports the organs of the senses, and the mouth and nose, for feeding, respiration, and voice.

The ribs, which form the sides of the thorax or chest, are articulated to the back-bone; and outside of these are placed the anterior extremities, which are arms in man, and fore-legs in most of the others.

Behind the chest the ribs cease; there is a portion where only the spine and soft parts occur, and then follow the bones to which the hinder extremities are articulated.

The more perfect formation of these bones is one of the most remarkable characters in the skeleton of the mammalia.

Q. Are there any other characters?

A. The mouth is always transverse, and there is never any motion in the upper jaw. In general, the mouth is furnished with teeth, which are formed in sockets, or alveoli in the jaw-bones; and very many have milk teeth, which they shed when young, while others have their teeth replaced periodically through life.

Q. What are the characters of the organs of the senses?

A. There are always two eyes for vision, two ears for sound, two nostrils for smell, the tongue and some of the soft parts of the mouth for taste, and the surface of the body generally for touch, though the latter sense is often peculiarly exquisite in certain parts, as in the human fingers, the trunk of the elephant, the tips of the wings in bats, and that particular part of the face in which the whiskers of animals that seek their food in the dark are inserted.

Q. What are the characters of their covering?

A. It is always skin, covered with various forms of hair, wool, and bristles; but these are never branched like the feathers or the down of birds.

Q. What are the characters of the sexes?

A. They are male and female of every species; the males are generally larger than the females; and th skins are often more hairy, and very often are furnished with horns, while the females have none.

Q. With regard to their young?

A. With the exception of two species (the porcupine ornithorynchus, nd duck-billed ornithorynchus), which are both natives of Australia, and but imperfectly known, they bring forth their young alive, and suckle them with milk.

Q. Is there no remarkable difference in this respect?

A. There is. In most of the species, the circulation of the young one is, before birth, connected with that of the mother through the medium of a *placenta*; but in a few, the young are contained in an external *marsupium*, or pouch, where, in the early stage of their being, they appear to be nourished by a sort of fluid in which they are contained, though they subsequently draw milk from teats or *mammæ*.

Q. What are the motions of the mammalia?

A. Walking, running, and leaping, are their general motions; but some have their extremities so formed that they can stretch out membranes and fly; some have their bodies formed for swimming; and as when the lungs are full of air, all are specifically lighter than water, they can all swim a little occasionally.

Q. Are any divisions made upon the structure of the organs of motion?

A. Those which have the hinder extremities adapted for walking, are called *pedata*, or footed animals; and those that have the hinder extremities formed into a sort of swimming tail resembling that of a fish, are called *apoda*, or footless animals.

Q. Are any distinctions made of the pedata?

A. Yes; they are divided into *unguiculata*, or those that have fingers or toes; and *ungulata*, or those that have hoofs.

Q. Any further distinctions?

A. Yes; from the form of the feet, and the mode of walking on them. If the feet have one portion which acts in opposition to the rest, in the same way that the human thumb acts against the fingers, so as to enable them to lay hold of bodies, they are said to have hands. If the bones of the hands be extended, and can stretch out a membrane for flying, they are called *chieroptera*, or hand wings; if they walk upon the flat parts or soles of the feet, they are called *plantigrada*, or sole walkers; and if they walk upon the toes, they are called *digitigrada*, or finger walkers.

Q. Are these the only characters by which the mammalia are classed?

A. No. The nature of the food of an animal is that which determines the greatest number of its habits; and as whatever that food is, the teeth are formed for preparing it for the digestive organs, the number, structure, and arrangement of the teeth are very important in forming a classification of animals.

Q. How many kinds of teeth are there?

A. They vary with the kind of animal; but, generally speaking, there are three. The *incisores*, or cutting teeth in the front; the canine teeth, tusks, *cuspidati*, or pointed teeth immediately behind these; and the *molares* or grinding teeth, toward the back part of the jaws.

Q. What are the respective uses of these teeth?

A. The *incisores*, are wedges or chisels for cutting substances in species; the *cuspidati* are a sort of daggers for wounding and tearing; and the *molares* are for chewing or bruising the food into a pulp along with the *saliva*, or moisture of the mouth.

Q. What are the great divisions of the mammalia, as founded on their characters?

A. There is no classification that is not liable to some objections; but Cuvier divides them into eight orders.*

Q. What are those orders?

A. 1. *Bimana*, or animals with two *hands* for grasping, and two *feet* for walking, but not for grasping.

2. *Quadrumana*. All the four extremities formed for grasping, and also for walking upon the palms.

3. *Carnassiers*, or "devourers of flesh;" very various in their appearances and habits.

4. *Rodentia*. With the fore-teeth adapted for gnawing, and without any canines; though some of them resemble, in that respect, animals that are classed with the "devourers of flesh," and are far more fond of flesh than several of those.

5. *Edentata*, or toothless animals, in which the fore-teeth are in general wanting, and the canine teeth in many of the species.

6. *Pachydermata*, or thick-skinned animals, in which the teeth, the characters, and the habits, vary very much.

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* See "Animal Kingdom, Class Mammalia," for ample, and in many instances interesting details.

7. *Ruminantia*, or animals that ruminate, or chew the cud. They have four stomachs, and in their natural state live exclusively on vegetables.

8. *Cetacea*. With the body more or less in the form of a fish. These in general are inhabitants of the water; but many of them sleep, and some of them graze on land.

Q. In which of these orders is there the greatest inconsistency?

A. In the "Carnassiers," which include the kangaroo, and some other Australian animals, that live wholly upon vegetables, and never touch an animal substance.

Q. Is that inconsistency corrected by any means?

A. The order is divided into four families:—

1. *Cheiroptera*, or those that fly, many of which are in their other characters more nearly allied to the quadrumana.

2. *Insectivora*, or animals that feed wholly or chiefly upon insects.

3. *Carnivora*, or those which properly belong to the class, and are furnished with the means of capturing, killing, and eating other animals.

4. *Marsupiata*, or pouched animals, some of which are carnivorous, and others not.

Q. Is there any inconsistency in any other of the orders?

A. Not in the name of the order; but the Edentatæ include the *monotrema*, or animals with one posterior aperture, which, though quadrupeds, do not appear to be mammalia; and if the absence of teeth is to be taken as the characteristic of a class, the common whale is as completely toothless as possible.

CHAPTER II.

ORDER I.—*Bimana.*

Q. DOES the order bimana include many animals?

A. Only a single species, *man.*

Q. What are the specific characters of man?

A. They are many; in appearance, in anatomical structure, and in habits; and they vary very much in different individuals; but they are always so clear and distinct, that even in the rudest and most unwonted state in which man has been found by his fellow man, there has never been the least danger of confounding him with any other animal.

Q. What are the most remarkable external characters?

A. Standing and walking in an erect posture, with the formation by which that posture is rendered natural to man, is the most remarkable character.

Q. Have no other animals the power of doing this?

A. Several animals can support themselves on two feet for a short time; but they do it awkwardly, and apparently with pain and effort, as they are obliged to throw their bodies into zigzags and contortions, in order to preserve their balance, or to support themselves upon surfaces that were not intended for that purpose.

Q. How do you know when the surface of any part of an animal is intended for being walked upon?

A. Nothing is easier. A surface so intended is always either covered with a hoof or horny substance of some description or other, or it is covered by a padding of an elastic matter, something like Indian rubber, which can bear a good deal of pressure without pain, and is so tough as not to be easily cut by the angles of stones and other pointed substances.

Q. And is this substance found upon the human feet?

A. It is; though among people who wear shoes from their infancy it is not much developed, because the artificial protection renders it unnecessary; but on those who go barefooted, the covering, especially of the heels, on which the shock and weight of the body are received after a leap, or any other exertion, and upon the ball of the foot, from which the weight of the body is projected forward in walking, leaping, or running, it is very conspicuous. In the human foot, however, the surface that can be made to touch the ground has a limit backwards that cannot be passed.

Q. What forms that limit?

A. The *Astragulus*, or heel-bone, by means of which the body is kept erect upon the soles of the feet; the portion of the back part of the leg, immediately behind or above this bone, cannot be brought in contact with the ground without an effort, even when the body is in a recumbent position.

Q. What is the particular difference in structure?

A. In those animals that are not handed, the tarsal bones, or bones of the feet, are very much elongated, and the base, or resting surface is obliquely on the point of the foot. Thus in the cow, the horse, and the dog, the *hock* joint is really that which corresponds to the ancle joint in man, and the hamstring, or large tendon of that joint, corresponds to the tendon Achilles in man, and like that is the cord of the muscles that extend the part; so that when the weight of the body is thrown upon the hind legs, the whole of its pressure tends to bend this joint, and force the tarsus down upon the ground; but when the animal is brought to repose on that part, the distance from the joint to the extremity of the foot is so long that there is little command over the extremity.

Q. Is it the same in all quadrupeds?

A. Not exactly. In the quadrumana, the tarsal bones are comparatively short; and the animal walks upon the palm or flat part; but there is no heel bone for support, and the cross strain resembles that upon the wrist when a man attempts to walk on his hands.

In the elephant too, and some others, the part is comparatively short; and the part that we are accustomed to call the knee really is so; but the surface of the hind part is not adapted for supporting the great mass of the elephant, without some assistance from the other parts of the body—the trunk, or the fore-feet.

Q. Is there no heel-bone in quadrupeds then?

A. There is a bone on the hinder articulation of the ancle-joint, which serves as a lever in giving purchase to the tendon in moving the foot; but other than the additional power of keeping the foot extended, that is given by this purchase, it is of no use to the animal in standing upon two feet. To man, standing erect on two feet is a position of repose, in which the muscles that extend and bend the limbs balance each other, and are at ease; but in the other animals, it is one of great exertion, as the whole strain is on the *extensor*, or stretching muscles.

Man stands on one foot with probably less effort than the quadrupeds do on two.

Q. Have you anything farther to remark about this erect posture?

A. The large base that man stands on from the peculiar structure of the feet; the perfect command that he has of the sole of the foot, so as to be able to balance himself on any part of it that he pleases; the width of the pelvis, which gives a greater base to the trunk of the body, and the bend outward at the upper end of the thigh-bones, by means of which, while the joints are placed nearer the centre, each leg acts as a sort of prop or strut to the other, at the same time that the strain upon the supporting bones is in the direction of their length.

Q. Does the rest of the structure of man accord with this position?

A. It does. The back-bone is uneasy unless it has an artificial support in every position except in an erect one; the head is uncomfortable in every position but vertical, unless when it reposes, as on a pillow; the mouth and nose are so formed that, bending to the ground on all fours, and without actually lying down, man could neither eat nor drink; and the range of the eye, in such a position, would be limited to a very small portion of the earth's surface—from this position man could take nothing for his support, how much soever he might be inclined to do so.

Q. Anything further ?

A. The hands are as ill-adapted for walking as the position of the head is for finding food in a recumbent posture. The fingers have not the same elasticity in opening as those of the animals which use their extremities alternately, as hands and feet; and the thumb is larger, and acts more directly in opposition to the fingers. The whole hand, indeed, admits of a variety of motions, of which there is no parallel one in nature, not even in the trunk of the elephant, which though a wonderful structure, is indefinite in its motions from the want of bones, the lengths and positions of which determine distances, and the joints or articulations form centres.

Q. Is there any other distinction between the human hand and those extremities of the other animals that are formed for grasping, and called hands ?

A. Yes; these are merely instruments for laying hold, and differ little in their use from the grasping feet of parrots and other birds, but are never used as constructive tools in half so efficient a manner as the bill of a swallow, or the tail of a beaver. The general distinction however, is, that the human hand can be educated—can be brought, by practice, to do any thing that the strength of its muscles can accomplish, while the hands of other animals cannot be educated, but only to a very trifling extent, and they do not practise what they are taught by man except under influence.

Q. What are some of the internal distinctions?

A. In the systems of circulation and digestion man does not differ much from the other animals that feed on the same kind of substances.

Q. What is the natural food of man?

A. If we could imagine man to be in a completely savage and uneducated state, destitute of skill and stratagem, and ignorant of the use of his grand and distinguishing auxiliary, *fire* (which, whether savage or civilized, is the grand sceptre of his dominion over the creatures), we would infer, from the equal lengths of his teeth, that he should live upon the mealy and pulpy parts of vegetables; but there is hardly any state in which his skill and stratagem do not enable him to catch and kill animals, which the use of fire enables him to dress and soften their flesh so that his digestive organs can act upon it.

Q. In what then consists the chief internal distinction?

A. Chiefly in the brain and nervous system, which, the former especially, are more abundant and more perfectly organized than in any other animals.

Q. And, as that is understood to be the source of sensation, are the senses more acute in man than in any other animal?

A. In some of the individual senses, or at least in certain uses of them, many of the other animals are superior to man,—as a cat can see in the dark, and a crow scent carrion from a distance of many miles, or a dog follow its master, or its prey, upon the scent; but taking all the senses into consideration, man may be pronounced to have more sensation than any other animal.

Q. Does that appear from anything?

A. Yes. We have no evidence that the other animals derive any pleasure from the senses—those of sight and smell for instance—besides the gratification of their appetites. The best bred dog in the world would not linger hungry in a garden of the sweetest flowers, nor stop to gaze upon the most exquisite picture or statue, if any garbage that could supply his appetite were accessible, even though surrounded by the most loathsome objects, and giving out the most offensive effluvia.

In man, there is always an inward something to be gratified, besides the merely animal appetite, which has the power of resisting that appetite; whereas, in the case of the other animals, the gratification of the appetite appears to be the only object.

Q. May not that be expressed by a sort of maxim or short saying?

A. Yes: "Man eats to live, and beasts live to eat;" and when we find that man so far forgets his grand distinguishing character as that what he eats and what he drinks are the sole objects of his attention, we characterize him as a man "of beastly habits."

Q. What is the most remarkable distinction in the external habits of man?

A. The facility with which his body tempers itself to the elements, although it has less natural covering than that of any other land animal.

Q. Does not that depend on his power of clothing himself?

A. No; it is independent of that. We are taught from the records of ancient historians, who could have motive for stating what was not true, that at one time the inhabitants of Germany and Britain went naked, or nearly so, and with but trifling differences of clothing, we find that those whose constitutions are "educated by the weather," and not in the artificial school of any fashion, the same race of men can exist from the ice-hut of the Polar regions, to the margin of the burning desart under the equator.

Q. And is that the grand distinction of man?

A. No. The mind—that which can be educated, which can educate itself. The capacity of deriving wisdom from his own experience as well as from that of others, of collecting and treasuring up that experience by means of language, so that that which is known at any one part of the world may be speedily known over the whole of it, and never can be lost;—that power which scrutinizes all the productions of nature; makes the knowledge of one the ladder by which a sure ascent is gained to the knowledge of another; which, from the contemplation of nature infers the existence and adores the wisdom, the power, and the goodness of nature's God; which from what it frames and what it feels, "takes hold on immortality" with a faith that cannot be shaken, and a hope which renders all the ills and reverses of life, troubles that are lightly to be borne, for the fulness of joy that shall come hereafter:—that is, the badge and character of rational man, which places him above all other animated beings, not in degree merely, but in kind, and classes him in the sublime language of holy writ, but "a little lower than the angels," than those intellectual existences which being uncompounded in their nature, require no supply by nourishment, a are exempted from the possibility of decay or dissolution.

Q. What is the probable result of the facility with which man adapts himself to the circumstances in which he is placed?

A. Probably those differences of external appearance, and certainly those differences of manners which we find in the inhabitants of different countries.

Q. Then there are not original differences?

A. Religion and philosophy combine in proving that they are all one species. "God made of one blood all the kindreds of men that dwell upon the face of the earth;" and philosophy proves that however different they may be in appearance, they are but one species.

Q. How does that appear?

A. The more we examine the laws or habits of natural beings, the more completely we find them to agree with the declarations in the Bible. Not only man, but all the species of organized beings have been made "after their kinds." Circumstances of climate and food, with many others with the peculiar effects of which we are not acquainted, may produce differences in appearance, greater even than those that exist between different species; but if they are of the same stock, they may be again united, but if different they cannot. All the varieties of the human kind may be thus blended together, the offspring of the two races partake of the variations of both; and any one might in time be lost as a black among whites, or a white among blacks, which never is the case with different species.

Q. Which are the principal varieties?

A. They have been so much blended together by conquests and colonizations, that it is not very easy to distinguish them; but the simplest and most obvious distinctions are those of colour.

Q. What are the chief colours?

A. White, black, and intermediate shades of olive; yellow, and bronze or red.

Q. In what part of the world are the whites chiefly found?

A. Chiefly from the British islands and Norway, southeastward toward India and the Bay of Bengal; but we find variations of them according to the colour, the whole passing into brown in the very warm countries, and also being darker in those that are very cold.

Q. Where are the blacks chiefly?

A. To the southward and eastward of the whites, in Africa, in New Holland, and in the central parts of some of the eastern isles.

Q. Where are the coloured races situated?

A. The yellow and olive to the north-east of the whites, and blended with some of the other races in the islands.

Q. Where are the bronze or red?

A. Chiefly on the American continent.

Q. Are those races distinct?

A. No, they are blended together in most places.

Q. Among which of them have the greatest improvements taken place?

A. Among the whites in their shades of colour, of which the eastern nations of antiquity, the Hindoos, the Ancient Egyptians, the Jews, the Greeks, the Romans, and the nations of modern Europe are instances.

Q. Which have been the next to them?

A. The yellow or olive, of which the Chinese and Japanese, with the different states that have from time to time been formed in the central parts of Asia, are instances.

Q. Which of the other colours follow next?

A. It is not very easy to say, as much less of their history is known; but probably the red men of America.

Q. Which have carried on the most extensive wars or inroads upon the others?

A. The white race and their connections certainly, who have visited every part of the world; and after them the yellow or olive; then probably some of the red races, as the Mexicans and Peruvians.

Q. But we read of African conquerors;—Hannibal, who invaded Italy; the Moors, who conquered part of Spain; and at an earlier period the kings of Egypt, one of whom (Sesostris) led his armies as far as India?

A. Yes; but though these were Africans, they were not negroes, but rather branches of the white race, darkened by climate and habits. We have no instances of a negro race, properly so called, or of any of the classes of the red men constructing any thing that could be called a ship, until the example had been set them by others.

CHAPTER III.

ORDER II.—QUADRUMANA.

Q. ARE there many species of the four-handed mammalia?

A. Naturalists enumerate about one hundred and fifty species; but as some of them have been seen only when young, and others only when full-grown, there is some uncertainty about them.

Q. What parts of the world do they inhabit?

A. The warm parts of it exclusively. Africa, the south of Asia, the Asiatic isles, and the central parts of America. They are not found in Europe, except upon the top of the rock of Gibraltar.

Q. What is the nature of their habitations?

A. Almost exclusively the woods, as their four hands enable them to climb trees with great facility.

Q. Are they numerous?

A. Exceedingly so, the smaller species in particular. The trees in many places are absolutely alive with them; and as they are very noisy, restless, and mischievous, the whole place is one continual noise and chatter.

Q. What are their popular names?

A. The large species that resemble man the most in their appearance are called apes; those that are less like man, baboons; and the small ones are in general termed monkies.

Q. Are those names sufficient for distinguishing them all?

A. They are not; the species are so numerous, that to understand them properly requires the use of many names, and also much careful examination.

Q. What are the principal divisions?

A. They are usually divided into *Simiadæ*, or the ape tribe, and *Lemuridæ*, or goblins; but to what these last owe that name, it is not easy to tell—possibly, as one set of superstitious persons took it into their heads that the apes were a sort of men, another race, finding that these were not quite so like men, resolved, if not to make devils of them, to call them devils.

Q. What are the principal genera?

A. They are three, *Simiadæ*, *Hapales*, and *Lemuridæ;* and the *Simiadæ* are generally farther divided into –1. Simia, the apes, monkies, and baboons of the eastern continent; and—2, the monkies of America.

Q. What are the general characters ot the simia?

A. They are found only in Africa, the south of Asia, and the Asiatic islands, but never in Australia or America. They live in the woods, climb trees, eat fruits, but not grass or leaves. They also eat insects, and many of the species of birds.

Q. What are the peculiarities of their structure?

A. They have some resemblance to man, but not so much as seen in the species that most resemble him in size to be compounded with even the most rude and unseemly portion of the human race. Their eyes are something like those of man in form and position, and they have the glance or transparent speck upon the *retina* in the back part of the eye which is peculiar to man, and to the quadrumana. They have four cutting teeth in each jaw, one canine tooth, and five cheek and grinding teeth on each side, both above and below; so that the number and arrangement of the teeth are the same as in the human subject, only the teeth do not in general stand so even, and in some the canine teeth are so long as to merit the name of *tusks*.

Q. Mention some of their other characters?

A. They in general have cheek pouches outside the teeth, the same as man; their noses have an unhandsome appearance, from the form and the closeness of the nostrils to each other; they are more or less covered with hair, and sometimes they have callosities or pads on the buttocks; so that though their attitude is not handsome, they can sit; some have no tails, and others have, of different lengths in the different species; but the tails of none of them are prehensile or *can grasp* like a fifth hand, as is the case with those of the American monkies.

Q. What are their manners?

A. Generally speaking they are mischievous and destructive, but the females are remarkable for their affection for their young. Their teats for suckling are on the breast, and two in number; they carry the young ones in their arms, or climb trees with them on the back, and clasping the neck. When the simia are wounded, they have something in their attitudes and cries much more nearly resembling the expression of anguish by human beings than is displayed by any other race; and this, with the resemblance, has made the superstitious impute to them many habits which they do not possess, and tell many stories of them which have no foundation but in the imagination and credulity of the narrators.

Q. Which are the most remarkable of the larger apes?

A. The most remarkable of the tailless apes that are destitute of cheek pouches (and it is somewhat remarkable that those which most nearly resemble the human race in appearance should be without this character), are the *Ourang-outang* (*Simia*), the *Chimpanse* (*Mimetes*), and the *Pengo.*

Q. What are the characters and country of the ourang-outang?

A. It is chiefly found in the woods of the Malay peninsula, and the adjacent island of Borneo. The height is from three to four feet, and the body covered with long red hair, thinly scattered. The face is of a blueish colour, and nearly one half is above the eyes, and there are no pouches in the cheeks. The ourang-outang is not so active and mischievous as the small monkies, and shews some affection for those that feed him. His hands enable him to imitate some of the simple actions of man; and he has a good deal of playfulness, but not very much title to sagacity. He cannot walk erect, nor even stand in that position, and even upon all fours he is a clumsy walker. He climbs and swings with ease upon the branches of trees; but owing to the structure of his hinder thumbs, which are short and often without nails, his hind feet are not so prehensile as the others.

His native habits are not much known, but he is fonder of fruit than of any other food, though he has no objection to raw flesh.

Q. What are the characters of the chimpanse?

A. The chimpanse is described as being a very rare inhabitant of the woods in those parts of Africa that lie very near the equator; as being a foot or more taller than the ourang-outang, and as being more fierce and mischievous in its disposition; but the accounts of animals of which living specimens are not often seen, require to be admitted with caution.

Strange stories are told about the chimpanse living in flocks, building huts, arming themselves with clubs and stones, and carrying off negro women; but most of these would need to be seen again before they are implicitly believed.

Q. What is the pongo like?

A. It comes from Borneo, which is also a native *habitat* of the ourang-outang; and it bears, at least in the specimen that is said to have been seen, a considerable resemblance to that animal, only the size is larger, the colour darker, and it is said to have cheek pouches, of which the ourang-outang is destitute.

Q. Which is one of the other classes?

A. The tailed monkies, which have in general cheek pouches, tails longer and shorter with the species, and varying considerably in size. They are inhabitants of Africa, and the south of Asia. In some places they attack orchards in troops, making a great deal of noise, and being by no means reluctant in biting?

The bite of most of the order, from the wedge-shape of their teeth, is apt to divide off the piece on which they seize.

Q. Is there any other subdivision of this tribe?

A. Yes; the baboons, which are described as be-more ferocious in their dispositions than any of the others.

Q. What are their habitats and characters?

A. They inhabit the same countries with the others, though different ones are found in different places. It is one of them, the Barbary ape, which is hairy all over, and of a grey colour, that has been naturalized upon the rock of Gibraltar.

The muzzles of the baboons are much longer than those of the apes and monkeys, and the nose comes quite down to the extremity, which gives the head something the air of that of a dog. They have cheek pouches, callosities on the buttocks, and many of them long tails; but it is not unusual for the exhibitors to cut off the tails, partially shave, and paint, and otherwise disfigure the animals, for the sake of producing apparent novelties.

Q. Which is the most remarkable of the baboons?

A. Probably that which is described under the name of the mandril, or maimou. It is described as a large and formidable animal, with blue furrowed cheeks, a scarlet nose, and the naked part of the buttocks of a beautiful violet. The colours are different at different ages however, and probably in different individuals; so that with that and with differences in the size, it is probable that this has been described as different species.

Q. What is its character?

A. It is mentioned as being a very fierce animal, and the negroes on the African shores speak of it in terms of horror; but how much of that may be owing to their own superstition, and how much to the real disposition of the mandril, has not been clearly pointed out.

Q. What are the characters of the American monkeys?

A. They are in general smaller than the large apes of the eastern continent. They have an additional grinder on each side of both jaws (making thirty-six teeth in all); they have no cheek pouches or naked callosities on the hinder parts.

Q. What are the subdivisions of them?

A. The *mycetes*, or howling monkeys; the *ateles*, or *sapajous*; the *cebus*, which have the tail long; and the *sakis*, in which the tails are not prehensile.

Q. What sort of animals are the howling monkeys?

A. They are of a reddish colour, about the size of a fox. There are two distinct species, the red and the brown—the latter usually called by the name of Beelzebub. They swarm in the central forests of America, and make the wild quite dismal with their cries; but they are relished by the people as food. They are enabled to make their hideous sound by means of a singular cavity in the bones at the larynx, or entrance of the wind-pipe, which acts as a sort of shell or drum. Their tails are long, naked, and prehensile.

Q. What are the sapajous like?

A. They have prehensile tails like the former, but have not the same frightful voices; there are varieties of them of different colours; most of them are rather small, gentle in their manners, and easily tamed. In most of the species the thumb is under the skin, so that they grasp only one way.

Q. What are the characters of the *cebus*?

A. The leading ones which distinguish them from the sapagous are a hairy, though prehensile tail; and the thumb developed, although short and of little service.

Q. What are the *sakis?*

A. They are little creatures about the size of squirrels, without prehensile tails: but they climb with facility, and hop from tree to tree when not too far distant.

Q. What are the *Hapalis?*

A. They combine some of the characters of the species of the east and the west. They have the same number of teeth as the former, are destitute of cheek pouches and callosities, and have the thumbs small and hardly of use, like the latter. The nails of the fingers are compressed, and pointed into a sort of claws.

Q. What are the general characters of the *Lemurideæ?*

A. In general their muzzle is long and pointed, which has procured them the common name of fox-nosed monkeys; they are in general covered with soft woolly fur, and they are chiefly found in the island of Madagascar, though some of the species are met with in Bengal, Ceylon, and other parts of the east. Those that inhabit the east are however much more slow in their motions, and generally have their claws and teeth more pointed.

Q. What is their food?

A. In many of the species it is fruits and roots, in others insects.

CHAPTER IV.

ORDER III.—*Carnivora.*

Q. WHAT are the subdivisions of this order?

A. 1.—*Cheiroptera*, or those that have the hands, or fine extremities expanded out into the form of wings.

2. *Insectivora*, or those which prey chiefly upon insects.

3. *Carnivora*, or those which kill and eat animals of larger size than insects.

4. *Marsupiata*, not named from their food, but from the female having an abdominal pouch, in which the young are covered.

I.—CHEIROPTERA.

Q. What is the common name of this division of the order?

A. Bats; but there are considerable varieties of them.

Q. What are their general characters and habits?

A. They agree with the quadrumana in having the teats upon the breast, and in some other particulars; but differ from them in not having the thumbs acting against the fingers, so as to be capable of grasping; and they resemble the carnivorous or rather insectivorous animals in the size of their tusks as compared with that of the animals.

Q. What further?

A. The bones of the hand are much elongated, and between the fingers there is spread out a thin leather like membrane, which is also connected with the side, and partially with the hinder leg, so as to spread out like a wing, and answer very well for flying; but their legs are weak, and they walk with difficulty, and in a very awkward manner.

Q. What are some of their habits?

A. They are crepuscular, or come abroad only in the twilight, and hide themselves in caves and other dark places during the day. Their eyes are generally very small, but their ears are large, and the edges of their membranous wings have an exceedingly delicate sense of touch. In countries where the winter is long, and the weather cold, they remain dormant during that season.

Q. As they have organs of flying, are they not a sort of birds?

A. They are so far from having any resemblance to birds in their structure, that they were classed by Linnæus in the same order with the quadrumana and with man. They have one part of resemblance to birds, and that is the ridge upon the breast bone, and a great mass of muscle upon each side for giving motion to the fore-arm and hand. In their flight they have none of the buoyancy of birds. They want the air pipes and cavities, by which birds are at once made light, and are enabled to breathe or aerate the blood through almost the whole of its circulation. They do not glide along like the birds of more powerful way, or jerk by occasional motions like other birds; they are in continual flutter; and notwithstanding the great expanse of their membranous sails, appear as if the air were not quite their element.

Q. Are they numerous and widely distributed?

A. They are. There is not a latitude or region of the world without its bat of some species or other. The warm countries especially abound with them, often of very large size; and in the caves in India, in New Holland, and in many other countries, they often repose in such numbers during the day as to absolutely darken the air when they are disturbed and driven from their retreat.

Q. How do they repose when in caves and other hiding places?

A. All of them have a hooked claw upon the thumb at the tip of the wing, and some have claws at some or at all the fingers, and they suspend themselves by these hooks.

Q. What are the principal divisions?

A. They may be divided into such as have claws on all the fingers, such as have them only on the forefinger and thumb, and such as have them on the thumb only.

Q. Which of them is the most numerous?

A. At present there is only one species known with claws on all the fingers, that is, the flying lemur or flying cat *(galeopithecus)*. The bones of its fingers are not elongated, so that the extension of the membrane rather breaks its fall, and enables it to leap as is the case with some squirrels and other animals, than assists it in flying by successive motions of the arms in the air. It is an animal of some size, lives in trees in the eastern islands, and is supposed to live upon insects, fruits, and probably birds.

Q. What are the characters of those that have a claw on the fore-fingers?

A. There are two subdivisions of them, those in which there are membranous appendages attached to the nose, and those in which there are not; the former are called *pteropus*, or "winged feet," and the latter *phyllostoma*, or "leaf mouths."

Q. Of what countries are the first of these natives?

A. Of various parts of the east. Some of them have been found in the tombs and caves in Egypt, and others in the eastern islands. The Oriental ones are by far the largest of the tribe, and much esteemed as food. They are inhabitants of caves or of trees.

Q. And where do the ones with the membranes on them now inhabit?

A. Various countries. One of the largest is the vampyre of South America, which is about the size of a pigeon, and is said to suck the blood of animals while they are asleep. The horse-shoe bats, so called from the form of the membranes on the nose, some of which are natives of Britain, though not very common, are a variety.

Q. Are these the bats that are found near houses on summer evenings?

A. No; the common bat has a claw only on the thumb.

Q. How many species of bats have been found in Britain?

A. Seven; three of the common bat, two of those with membranes on the nose, and two with the ears reunited. Some of them are, however, very rarely to be met with.

II.—INSECTIVORA.

Q. What are the characters of the insectivora?

A. They are mostly nocturnal animals like the bats, but they are destitute of the flying membrane. They walk upon the webs of the feet; most of them have five toes on all the feet, furnished with claws, and in some of the genera the claws are adapted for burrowing in the earth. Some of them are also covered with spurs of greater or less consistency, and others with remarkably sleek and beautiful fur. The legs in all are short, and the motions slow.

Q. Which are some of the genera?

A. Hedgehogs, which burrow in the earth or form nests under hedges. They are armed with strong and sharp pointed bristles, and are capable of rolling themselves up into the form of a ball for defence. They are found in all the temperate parts of Europe. There are some varieties of the hedgehog, and there are also some others found in Madagascar which have spines on their back, but which are incapable of rolling themselves up.

Q. What are the other genera?

A. Chiefly moles and shrews of various species and varieties, which burrow in the ground, and feed upon insects and earth-worms. As their habits are much in the dark and under the ground, they have in general very small eyes, but their sense of hearing is very acute. The moles especially are very voracious little animals; and if two of them be confined in any place without food, a battle ensues, and the vanquished is eaten.

Q. Is there anything in the formation of the teeth of those animals that tends to restrict them to insect food?

A. Yes; the upper surfaces of the cheek teeth are formed into sharp points, so as not to be well adapted for bruising flesh or vegetable substances.

III.—CARNIVORA.

Q. What animals are included in that branch of the order?

A. Those that have their teeth adapted for tearing and bruising flesh, and at the same time possess sufficient stratagem, strength, and courage for catching and killing their prey.

Q. Do they all live exclusively on animals that they kill?

A. They occasionally eat other substances, but the greater number prefer living prey.

Q. What are the characters of their teeth?

A. They all have six cutting teeth in each jaw; the canine teeth are long and strong, and their grinding teeth are invariably adapted for cutting and bruising, so as to allow of a considerable range of food in the different species.

Q. What are the principal subdivisions?

A. The order is a very extensive one, including some of the most powerful of animals, and others that are comparably small; but they are all endowed with great strength in proportion to their size, and have a sort of instinctive knowledge of the places in which their prey may be mortally wounded. The most obvious division is into those that are *plantigrade*, or walk upon the soles of the feet; and *digitigrade*, or those that walk upon the points of the toes.

Q. Which of these are the most numerous?

A. Those that walk upon the toes are by far the most numerous.

Q. Are there any remarkable characters in those that walk upon the soles of the feet?

A. They have the clavicle or collar bone wanting, or imperfectly formed; they are animals that can either eat voraciously, or bear the want of food for a considerable time.

Q. Of what parts of the world are they inhabitants?

A. Of various parts; but the most powerful are inhabitants of the colder regions, where they pass a considerable part of the winter in a dormant state.

Q. What are the chief animals in the division?

A. Bears, badgers, gluttons, racoons, and some others.

Q. What are the principal characters of bears?

A. They are clumsy-looking animals, with a rough, shaggy coat, thick limbs, the fore ones close together, in consequence of the absence of the clavicle. They are very strong; but they prefer honey and berries to animal food. Though unwieldy, they climb with great ease; and as their fore-legs come almost close together from the shoulders, they squeeze and hug with great force.

Q. What are the principal colours?

A. They are various shades of brown, from very pale to almost black; but in the land-bears the difference of species is not very well defined.

Q. In what countries are they found?

A. In the forests of the northern parts of Europe, in North America, in India, and in some other places.

Q. Is there not also a sea-bear?

A. Yes, there is, which inhabits the polar seas, lives upon seals and other marine animals, and is often transported to considerable distances upon boards or islands of ice. It is a larger animal than the land-bear; and as its food is more exclusively animal, it is probably more savage.

Q. What are the characters of badgers?

A. They are animals which burrow in the ground, and seldom come abroad but during the night. They are peaceable animals, but bite severely when they are attacked. They exhale a strong and by no means agreeable odour.

Q. What are the characters of the glutton?

A. It is found in the very coldest parts of Europe. It is about the size of a badger, but of a much finer colour, and much more of a carnivorous animal. It does not, as is said, eat at one meal an animal larger than itself: but it lies in wait in trees, and drops down upon its prey, so that the speed of the rein-deer is no security against it.

Q. What sort of animals are racoons?

A. They are nearly the size of badgers, but handsomer. In their wild state they eat insects, eggs, and birds. They are nocturnal in their habits, and so are the coatis, a race very analogous in many resects. These are inhabitants of warmer regions than the bears, and are found chiefly in America. The smaller races of plantigrade carnivora resemble the weazels in some of their habits.

Q. What are the digitigrade carnivora?

A. They begin with the dog, (which, though a cruel and ravenous animal in some of the species, yet has not the teeth adapted so exclusively for animal food as some of the others,) and proceed by a regular gradation, more and more carnivorous, to the cat, which genus contains the most ferocious, powerful, and sanguinary of all the mammalia, the lion and the tiger.

Q. What are the characters of the dog?

A. There are two grinding teeth on both sides in each jaw, adapted for bruising vegetable substances; they have a soft tongue, four toes on the hind feet, and five on the fore.

Q. What other animals most nearly resemble the dog?

A. The wolf and the jackall, the former an inhabitant of some of the forests of Europe, and the latter of warmer countries. Though the jackall prowls at night, its eyes have the circular pupil of those of the dog, and not the linear nocturnal one of the fox.

Q. How do the foxes differ from dogs?

A. In the form of the pupil of the eye, as has been mentioned; in their superior cunning, in burrowing in the ground, in having a peculiar odour, a more bushy tail, a more elongated muzzle, and a certain obliquity in the opening of the eyelids, which gives them a peculiarly sinister look.

Q. Does not the hyæna resemble the dog and the fox?

A. In some particulars it does; but the absence of teeth adapted for the bruising of vegetables, indicates a much more carnivorous disposition. The teeth of the hyæna are remarkably well fitted for breaking bones.

Q. Of what countries are they natives?

A. There are at least two species: a spotted one in southern Africa, and a striped one in the centre and north of Africa and the south-west of Asia.

Q. What are some of the other divisions?

A. The *viverradæ*, named from the civet, contains that animal, the genet, the ichneumon, and some others. They have one bruising tooth on each side of the lower jaw, the tongue rough, and the claws partly retractile.

Q. Of what countries are they natives?

A. The civet is a native of the warmest parts of Africa; the genet of Africa and the south of Europe, and the ichneumon of Egypt, where it is domesticated and kept for the purpose of clearing the houses of vermin. There are many varieties of these animals.

Q. Are there any nearly allied to these?

A. There are many small but powerful animals—martins, polecats, weazels, and a variety of others, which are very destructive of birds, and all quadrupeds that they can master. Many of them are found in very cold countries, such as the north of Asia and America. When taken in the winter there, their furs are very valuable, and form a considerable branch of ·ade.

Q. You mentioned that the cats are the most sanguinary of animals, are they a numerous genus?

A. They are very numerous, and dispersed over most parts of the world; but the more formidable ones, such as the lion and the tiger, are confined to the warmer latitudes, and even there they are chiefly found in forests and unfrequented places.

Q. Are not some of the carnivora *palmated*, or have webbed feet adapted for swimming?

A. Yes; the otter, which in other respects is a regular quadruped. It feeds chiefly on fish, and frequents the banks of rivers. There is also a sea-otter, which is much larger than the fresh water one.

Q. Are there not some others that have still more aquatic habits?

A. Yes, the seals, which have a good deal of the shape of a fish in the body, and the hinder extremities formed into a sort of tail, but still retaining the claws. The seal has many valuable qualities, and among the rest it is easily tamed, and might be turned to use, both in catching fish, and for the sake of its oil and its flesh. The walrus is another animal, having many of the habits of the seal. The tusks in the upper jaw are very much lengthened, and turned downwards; so that they assist the animal in climbing masses of ice in the Polar seas.

IV.—MARSUPIATA.

Q. What is the distinguishing character of these animals?

A. A marsupium or pouch in the female, in w the teats are wholly or partially included, and the young carried.

Q. Are they numerous?

A. They are not very numerous except in Australia, where, with the exception of a dog, or one species of rat, both of which have probably been imported, they are the only native quadrupeds.

Q. Are they confined to Australia?

A. No, there are a few in central America, and in some other places, but they are of different species from the Australian ones.

Q. What are some of the other characters?

A. They have two peculiar bones for supporting the pouch, which are articulated to the front part of the body, and have muscles attached to them for giving peculiar motions to the pouch. The young are in all the species produced or grow upon the teats, and have at first the form of little knobs, without any perceptible rudiments of the limbs or other parts of animals. But these are in time developed: the little tube by which each was fastened to its teat divides and wastes away; the teat then produces milk, and the young one, which has now the proper form of the animal, sucks like the young of the other mammalia.

Q. What are the American animals of this subdivision?

A. They are known in English by the general name of opossums; some are about the size of cats, and others are not much larger than rats. They have all the characters of carnivorous animals, and they live upon animal food, some frequenting the sea-shores, and living on crabs and other shell-fish. They have not strength and size for attacking very large animals. They have prehensile tails, and the thumb on the hind foot acts in opposition to the fingers; thus forming a sort of hand.

Q. Which are the Australian species that are carnivorous?

A. They get the name of *dasyuri*, or rough tails, because their tails, which are not prehensile or capable of laying hold, are covered with very long hair. The pouch does not extend so far forward in these as in some of the others.

Q. Are they large?

A. Two species, one with short hair and a head something like that of a dog, and another with long shaggy hair like that of a bear, black, but mottled with grey, are almost as large as moderately sized dogs. They are found chiefly or exclusively upon Van Diemen's Land; they are retired animals, and not very often seen. The bear-looking one (*D. Ursina*) is chiefly found in the fastnesses of the brake or "bush," as it is called in that country, and is styled a hyæna by the colonists. The other, which is more frequent on the sea-shores, where it feeds on dead fish and other putrifying substances, and sometimes catches live fish, has been dignified with the name of the devil. A number of smaller species have been mentioned, but they have been so seldom seen that nothing very positive can be stated respecting them. There is a dark one with lighter spots, however, about the size of a martin, which has been seen in Australia.

and has been called the wild cat, though it has none of the characters of that tribe.

Q. What is the next division of the Australian marsupiata?

A. Parameles, or those that resemble badgers. They are much less of a carnivorous structure than the former, and have the tusks in the lower jaw either very small or wholly wanting. Their front teeth are well adapted for gnawing bark; they burrow in the ground; they are small and harmless animals, and subsist upon vegetable substances and insects.

Q. Is this division of the marsupiata confined to Australia?

A. The particular species that are found there may, but there are others in the Oriental islands which very much resemble them. Those (from *pelander*, the Malay name for a rabbit, which they resemble both in size and in their habit of burrowing,) have been called *philanders*.

Q. Can any of the marsupiata fly?

A. Not fly absolutely, but there are many of them which live in the forests of Australia that can stretch a sort of membrane between the fore and hind leg on each side, and by that means leap to a great distance. They are popularly called flying squirrels, or flying foxes, according to their size.

Q. Are there any others?

A. There are two distinct genera, the *koula* and the *wombat*, which have almost exactly the manners of rabbits, and would deserve to be ranked in the same order, were it not that they have the marsupium, or pouch. They are very gentle creatures, and easily tamed.

Q. Are there no larger animals of the class?

A. Yes, the kangaroos, which are the cattle or grazing animals of Australia. They are remarkable for the length and strength of the hind legs, and the smallness and feebleness of the fore ones. Their walk is on the two hind feet, and they bound along with very singular hops. There are several species of them, some larger and others smaller, but their general form and habits are very similar.

Q. Then there are resemblances of many animals among the marsupiata?

A. There are; but they all have the singular character, that the young first grow like buds, which is a character of the very lowest tribes of animated beings; and then draw milk from the teats of their mothers, which is a character of the very highest, and of man himself.

CHAPTER V.

Order IV.—Rodentia.

Q. What is the general character of the *rodentia*, or gnawing animals?

A. They have two large front teeth in each jaw, that have the points formed like chisels, with the cutting edge outwards; and these are separated by large vacant spaces from the grinders: there being no tusks or canine teeth in any of the order.

Q. What does such a structure of the mouth form?

A. It forms a perfect pair of cutting pincers, such as those that are used by workmen for cutting wires asunder. If an animal with teeth of this description were to bite, it would not merely wound or tear like the carnivorous animals, but it would cut out the piece.

Q. Are they carnivorous then?

A. In general they are not, their grinders are chiefly adapted for bruising vegetable substances; but there are others with the upper parts of the cheek teeth formed into points, which eat animal matter and sometimes kill very small animals.

Q. Is there any thing worthy of remark about the growth of the teeth?

A. There is. In all the species the front teeth are an apparatus for cutting the food, and they are unsupported by canine teeth; and in many they act as a saw or hatchet in working—in felling timber and dressing it, or in cutting passages through boards, so that they are much subject to wear.

Q. Is there any provision made for this purpose?

A. There is never any purpose in Nature for which there is not a provision, and a provision much better calculated for answering that purpose than any human contrivance answers the purposes of man.

Q. What are the particular ones in the case of the front, or gnawing teeth, of the rodentia?

A. In order that the teeth may have the requisite hardness and yet not break, the outer surface consists of a plate of the very hardest enamel, and this enamel is supported by a much thicker plate of common ivory, or "tooth-bone," which, while it is tough, and would bend without snapping asunder, is yet so soft that those substances which the edge of the enamel can divide, easily wear it down, and bring the cutting edge of the tooth to the same sort of surface as that of a chisel, which has a thin plate of hard steel upon the front, supported by a thicker mass of tough iron on the other side, which supports the steel, but is ground off into a slope or basil, so as not to interfere with the cutting powers of the steel. Contrary to most teeth, too, those gnawing teeth have a power of constant growth, so that as they waste away at top, they are supplied from the root.

Q. What is the most general division of the order?

A. Into those that have collar bones, and those in which these are wanting or imperfect.

Q. How are they further subdivided?

A. Into those that have the gnawing teeth more or less pointed, and tubercles upon the grinders, and those that live partially on animal food.

Q. Which are the genera?

A. The prevailing ones are:

1. *Hydromys*, (water-mouse,) an animal about a foot in length, with the hind feet webbed, and having many of the characters of the carnivora. Its habits are not much known, but it is supposed to be met with on the desolate coasts of New Holland as well as in tropical America.

2. The *hamster*, a native of the north of Germany, and all the sandy countries eastward; of a

colour, marked with white; rather larger than a rat; has cheek pouches which it uses as collecting baskets. It hoards grain.

3. *Dipus*, (two feet, from the length of the hind ones,) the jerboa. A lively little animal; native of rather warm countries; has no cheek pouches; burrows, but does not hoard for the winter; hybernates in a dormant state.

4. *Mus*, (the mouse,) including all the tribes of rats and mice which are many, and abundant in individuals.

5. *Arctomys*, (bear-mouse,) the marmot. Inhabitants of cold countries and lofty mountains. There are several species, some as large as rabbits. They live in societies; burrow in the earth; hybernate; are easily tamed, but survive the winter with difficulty.

Q. Which are the genera that have the teeth chisel-shaped?

A. The following are some of the chief.

1. *Spalax*, (a mole, probably the mole of the Greeks,) mole-rats. A curious genus. Mine the ground like moles. European species confined to the east of the continent, having the eyes under the skin, and so small as to be invisible; others with visible but very small eyes. Some in Southern Africa nearly as large as rabbits.

2. *Cheiromys*, (handed mouse,) the *Aye-Aye*, a native of Madagascar; has something the appearance of a monkey; has very long fingers on all the four extremities, with long and sharp claws, and the thumbs acting against the fingers. Is timid, feeds during the night, and is named from its cry.

3. *Pteromys*, (winged mouse, or flying squirrel,) has the habits of the common squirrel, but can support an extensive leap by means of a membrane extended between the fore and hind legs.

4. *Sciurus*, (shadow-tail, alluding to the power that they have of shading themselves with their long and bushy tails,) the squirrel. All the species are playful creatures, expert climbers and leapers; live in trees, and feed upon nuts and fruits, or, in the absence of those, buds and seeds.

Q. Which are some of the genera that live upon vegetable matter, as on grass and bark?

A. The following are some of them.

1. *Lepus*, (downy foot,) including the hare and the rabbit.

2. *Echimys*, (spiney mouse,) porcupine, of which there are several species; inhabitants of warm or moderately warm countries. The common one is found in the south of Europe, and is about the size of a hare; there is one in Mexico with a prehensive tail. The porcupine is a very timid and inoffensive animal, and its flesh is well flavoured. The spines are wholly for protection; it burrows like a rabbit, and hybernates in its colder localities.

3. *Fiber*, (the musk-rat, or musk water-rat,) is about the size of a small rabbit; has the scaly tail and many of the habits of the beaver; feeds mostly on the roots of aquatic plants. Is found in the north parts of America, in societies like the beaver.

4. *Georychus*, (the lemming,) a native of the mountains of Norway and other cold countries, from which it descends periodically in vast numbers, and

sumes the whole vegetation of the fields. During these migrations vast numbers of them are captured by birds of prey.

Q. What are some of the other genera?

The *cobaya*, or Guinea pig, the *agouti*, which is a burrowing animal, and one species about the size of a hare digs the plains of Paraguay full of *vizcachèros*, or burrows, hence its common name of *biscachos*.*

Castor, the beaver, which belongs to the same branch of the division in some of its characters, but differs in others, and is the nearest approximation in structure to those indolent animals the *monatremata;* at the same time that it exhibits mechanical powers superior to any of the other mammalia, is one of the most interesting of animals.

CHAPTER VI.

ORDER V.—EDENTATA.

Q. WHAT are the characters of that order?

A. They are without incisive teeth, and some without teeth altogether, and even without regular jaws; they have very large nails, and their motions are in general exceedingly slow upon the ground, though those of them that live in trees are excellent climbers.

Q. What are the divisions of the order?

A. The principal ones are three—sloths, which have teeth, though no incisors; those which are without teeth, but retain something like the mouth of a quadruped; and those which have a bill instead of a mouth. The last are the *monotremata*, the animals which, though they have four feet, and a hairy or spinous covering, the internal structure resembling the mammalia, and destitute of the means of flight like birds, yet do not suckle their young, or at least have not been proved to do so.

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* See Captain Head's "Rough Notes on the Pampas."

Q. What are the characters and habitats of the sloths?

A. They have canine and grinding teeth. One species has three nails on the fore-feet, and the other only two; they are unshapely in their form, and unwieldy in their motions; live mostly on trees, and as the repose of the feet is with the claws compressed, they hang by these to the branches of trees, when they sleep. They are natives of South America.

Q. Is there any other toothed genus?

A. Yes, *dasypus*, which have the feet formed for burrowing. They are without canine teeth, and some have front teeth, some not, but they all have grinders. They are inhabitants of the warm parts of South America, where they live in the woods, and feed indiscriminately upon the roots of plants, insects, and on animal substances.

Q. What is their common name?

A. They are called "*armadillos*," and also "shield-pigs," or "hogs in armour."

Q. Why do they get these names?

A. Because they are covered with horny plates, like the pieces of a coat of mail. These plates consist of a greater or smaller number of bands, or pieces which are moveable at the joints, and the animals can roll themselves into balls covered with these for protection, in the same manner as the hedgehog is by its spines.

Q. Are any of them large animals?

A. The largest is about three feet and a half in length, exclusive of the toes. It is covered with a great number of jointed bands, and has very powerful claws on some of its four feet. Some of the species are hairy, and have hairs even on the horny plates.

Q. Is there any other genus with teeth?

A. The Cape ant-eater, which is a burrowing animal with large pointed ears and a pointed muzzle, short feet and digging claws, but covered with hair, and not externally like the armadillos.

Q. Which are the genera without teeth?

A. 1. The *ant-eaters*, which have the body covered with hair, and the tongue very slender, capable of being projected out of the mouth and drawn in again; and being covered with a viscid substance, to which the ants and other insects upon which the creature feeds adhere. The ant-eaters are natives of South America.

2. The *manis*, which also has a projectile tongue, and the feet adapted for digging; but it is covered with scales that overlap each other like the tiles of a house. It can roll itself into a ball like the armadillos. It is a native of the east.

Q. Is not the manis very like a lizard?

A. In its external appearance it bears a considerable resemblance to that class of animals; but it differs entirely in the internal structure, and especially in the suckling of its young.

Q. Which is the last class of the toothless animals?

A. The *monotremata*, or that singular class that have but one posterior opening.

Q. What are the genera of these animals?

A. There appear to be two distinct genera, and only one species of each, for the more minute distinctions that have been noticed, appear to have an accidental foundation, if indeed any foundation at all, in nature. Those genera are *echidna* and *ornithorinchus*.

Q. What is the general appearance of the animals?

A. The shape of the body and limbs of each is not unlike the same part of a mole. The echidna has the mouth drawn out into a long tube or pipe, from the orifice of which the tongue is protruded in the same manner as is done by the ant-eaters. The ornithorinchus has the mouth formed into a bill, not unlike that of a duck, with a very sensitive membranous edge, and the tongue is not projectile, like that of the other. The feet of both are adapted for burrowing, though, if one may judge from appearance, the echidna have their feet best adapted for that purpose.

Q. With what are their bodies covered?

A. The echidna with spines, which though, from the inferior size of the animal, not nearly so large as those of the porcupine, are thicker in proportion to the length. They are hollow, and sharp at the points, so that the animal cannot be touched without the risk of a wound. The ornithorinchus is covered with hair, which, from the glossiness of its surface, appears to be very soft; but the hairs are hollow, and conical, very much resembling the larger ones that grow upon the beaver.

Q. What are their habits?

A. The ornithorinchus is aquatic, and appears to seek its food in the muddy hollows of water in the same manner as a duck. The echidna burrow in the earth, and live upon insects. They are found only in New Holland, and are rare even there.

CHAPTER VII.

ORDER VI.—PACHYDERMATA.

Q. WHAT is the meaning of that name?

A. It means thick-skinned.

A. Is that the only character of the order?

A. That is general to the order, and the other characters are so varied that it is convenient to subdivide the order.

Q. What are those divisions?

A. They are—

1. *Proboscidiana*, or animals that have prehensile trunks, which consist of the elephants.

2. *Pachydermata*, which may include the other thick-skinned animals that have divided hoofs.

3. *Solidungula*, or solid, or entire hoofed, the horses and the kindred races.

Q. Is the upper lip of no animal prehensile but the proboscis of the elephant?

A. The lips of all animals are capable of taking hold to some extent or other, and that of the rhinoceros can pull grass; but the trunk of the elephant is superior to them all, it being a universal hand, indeed two hands, for the animal can hold a branch in a coil of the trunk, and pull off the leaves with the thumb-like process at the point.

Q. Are the large tusks of the elephant, which project from the mouth and furnish the ivory of commerce, canine teeth?

A. No; they are in place of front teeth.

Q. What other teeth has the elephant?

A. Only flat-crowned grinders, composed of alternate portions of ivory and enamel, by means of which it can browze vegetable substances, even though very tough; but the animal is incapable of biting or of eating flesh.

Q. Are there more species of elephants than one?

A. There are two living species, the Asiatic and the African. Their native haunts are in the forests of south-eastern Asia, and in Africa, where they live in herds.

Q. What are the specific differences?

A. The Asiatic elephant is of a larger size, has a more oval head, smaller ears, and a less elevated crown of the head than the African. The ridges of enamel in the crowns of the teeth are also more wavy, and there is a toe more upon each of the hind feet.

Q. What is the size of a full grown elephant?

A. An Asiatic one of the largest kind is about ten feet high: the African is less.

Q. Is the skin of the elephant impenetrable as well as thick?

A. No; for the flies annoy him as much as they do any other animal.

Q. Was there never any species of elephant but these two?

A. There has been one, a stronger animal, with larger tusks, and capable of living in cold countries, which inhabited the north of Asia, Europe, and America; but it is now extinct, and only the bones are found.

Q. Which are the genera of the pachydermata, properly so called?

A. The chief ones are these—

1. *Hippopotamus.* A large and unwieldy animal, with incisors, canine and cheek teeth, that inhabits the larger rivers of Africa. They live upon the roots of aquatic vegetables, and also on those by the sides of rivers. They are dull and sluggish animals, but ferocious when enraged.

2. *Sus* (the hog), of which there are several species, and many varieties. One of the most remarkable is the babyroussa, a native of the east, which has the tusks curled up like horns.

3. *Phasco-chæres* (warty swine), the Ethiopian boar with fleshy lumps on the cheeks, and the tusks round, strong, very large, directed outwards and upwards, and presenting a very formidable appearance. It is in the male only that this genus has the formidable tusks and the shaggy mane; the female has the tusks in the form of larger teeth, and is rather shaggy all over. The genus is a native of Africa.

4. *The pecary,* a much smaller and and less formidable looking animal than the other. There are two

species, one about half the size of a hog, and one a little larger. They are abundant in the South American forests, and much feared by the natives.

5. *Rhinoceros.* Probably the largest land animal after the elephant. It is a clumsy animal, with wrinkles or folds in the skin, short thick legs, and three toes upon each foot. It inhabits nearly the same places as the elephant, but is a duller animal.

Q. Are there more than one species?

A. There are three. The Indian with only one horn on the nose, and large folds in the skin; and the Sumatra, and the African, generally with two horns, and the skin without folds.

Q. Upon what part of the rhinoceros is the horn situated?

A. Upon the nose; and it is literally a horn, for it is composed of horny fibres growing from the skin over a strong base of bone, so that it can hardly be broken, and the severest blow that can be struck with it gives not much pain to the animal.

Q. Are there any other genera?

A. The most remarkable one is the *tapir*, of which two species have been seen, one in South America, which is altogether of a dark colour; and one in Sumatra, which has the middle of the body light. The snout is very long and moveable, adapted for poking in streams, by the sides of which the animal is found. Like the common hog, it is not very choice in its food.

Q. Which are the solid-hoofed pachydermata?

A. There are four principal species; the horse, the dziggetai, the ass, the zebra, and the quagga, none which are natives of America. They feed only on vegetables. They have incisive and grinding teeth, and the males have generally small canine ones, but not the females.

Q. Of what country is the dziggetai a native?

A. Of the dry plains in central Asia. It is an active animal, intermediate in size between the horse and the ass, but has never been domesticated.

Q. Of what country is the quagga a native?

A. Of Southern Africa, where it is found in herds, and often becomes the prey of the lion. It resembles the zebra in form, but the markings are not so handsome.

CHAPTER VIII.

ORDER VII.—RUMINANTIA.

Q. WHAT is the most general character of that order of animals?

A. That from which the class is named,—ruminating or chewing the cud.

Q. What does that mean?

A. These animals have four stomachs. First, the *paunch*, which is a mere receptacle for the food in a rude state; secondly, the *king's hood*, which is honeycombed on the inner surface, and into which the drink of the animal passes at once, while the food passes by degrees; thirdly, the tripe, or *manyplies*, which contains a great number of folds; and, fourthly, the *red*, which more nearly resembles the single stomach of other animals.

Q. But that does not explain what is meant by ruminating?

A. It is necessary for it. The first stomach is a mere reservoir for the food, and the second is one for drink, and for mingling that more or less with the food (in some genera, as the camel, there are cells in which a supply of water can be contained, and discharged from time to time into the second stomach). The food, as taken into the stomach, is not chewed; but when the animal has taken enough, and it begins to pass into the second stomach, it is thence returned to the mouth mixed with a portion of the drink, and when sufficiently bruised by the grinders, it is swallowed a second time, passes into the second and third stomachs, and is digested in these. This return to the mouth, for the purpose of being digested, is ruminating or chewing the cud; and if the animal be in health, the food returns to be chewed unaltered, and, of course, without any offensive smell.

Q. Are the ruminantia numerous?

A. They are; and they are of all animals the most useful to man. They find him food and clothing; they carry him and his burdens, and they do his work.

Q. Which are some of the races?

A. The most remarkable ones are—

1. The camel tribe, containing, the camel with two lumps on the back, and the dromedary with one—these have the feet much padded, and small nails or hoofs on the two toes; and the lama, the guanaco, the paco, the vicugar, the chilikuque, and the

huemel, all without lumps on the back, smaller than the others, and natives of South America, as the others are of Asia.

2. *Musks*, smaller animals, some of them secreting a perfume, have the hoofs divided, found only in Asia in mountainous places.

3. *Deer*, the male have horns mostly branched or palmated. Very numerous, and found in all latitudes. Generally fleet and timid.

4. *Giraffe*, or cameleopard, only one known species, remarkable for the height of the shoulders and head.

5. *Antelopes*, very many species, all of them fleet, and many of them very handsome animals. Chiefly inhabit Asia and Africa; some in Europe. The American genera or species a little doubtful.

6. *Goats*, species not so numerous as the antelopes, but individuals very abundant.

7. *Sheep*, of which there are many varieties.

8. *Oxen*, of which there are many species, including buffaloes, bisons, and a number of others.

A. Are these all the genera?

Q. Not nearly: a mere list of them would fill a considerable volume.

Q. What is to be observed of the order generally?

A. That the flesh of all may be eaten; that many of them furnish milk, butter, and cheese; that in most states of society they have formed a large portion of the wealth of man.

Q. Are there any fossile ruminantia?

A. Yes, especially of the larger deer.

CHAPTER IX.

ORDER VIII.—CETACEA.

Q. What do you understand by cetacea?

A. Animals which have the structure and habits of whales.

Q. What are their leading characters?

A. They have red and warm blood, breathe atmospherical air, and suckle their young; but they have the fore-extremities formed into swimming paws, and the hind ones into a tail bearing some resemblance to that of fishes.

Q. Then they are all inhabitants of the sea?

A. They are all inhabitants of the water; but some of them are found in rivers, and they quit the water for the purpose of grazing in the meadows.

Q. And do these belong to the same order as the whales?

A. Properly speaking they form a sort of sub-order. They are animals which with some of the habits of the whales, live by bruising vegetable matter. They have been called sea-cows, sea-horses, mermaids, and other names, and strange stories have been told respecting them.

Q. And is there no foundation for the numerous stories of the mermaids?

A. No better than there is for the centaurs, the men without heads, or any of the fabled monsters of antiquity.

Q. Which are the animals to which you allude?

A. The *manatis* or *lamantins*, the *dugong*, and the *stellere*.

Q. Where do the lamantins inhabit?

A. The great rivers of tropical America and Africa, which empty themselves into the Atlantic, particularly the river Amazon, where they are found in great numbers, and many hundreds of miles from the sea.

Q. By what name is the animal known in South America?

A. The descendents of the Spaniards call it *vaca marina*, or sea-cow.

Q. Is it a large animal?

A. When full grown it is about twelve feet in length, and nine or ten in circumference, though it is sometimes said to attain the length of twenty feet.

Q. What is its appearance?

A. It is a clumsy animal, of a brown colour, with the skin generally naked, but having a few grey hairs about the upper lip. The head is very large, and but that the upper lip is divided, the muzzle has some slight resemblance to that of an ox.

Q. Why is it called manati or lamantin?

A. From the fancied resemblance of the swimming paws or fore-extremities to hands.

Q. And are they not like hands?

A. They are not, any farther than having fingers within the skin that supports the fins.

Q. Are they not adapted for motion on land as well as in the water?

A. They are partially so, as two of the fingers on each paw have nails or claws; but the motion on land is waggling and unweildy.

Q. What is the character of the hinder extremities?

A. They are formed into a sort of swimming tail, intermediate in form between those of the seal and the whale, or cetacea, properly so called.

Q. What are the habits of the lamantin?

A. It is a very peaceable animal, and resembles the ruminating land animals in living in herds, and it feeds exclusively upon vegetables.

Q. Is its flesh eatable?

A It is eaten, and tastes something like veal. The fat too, which covers the whole flesh, under the skin, like the blubber of the whale, yields a considerable quantity of oil.

Q. Is the African lamantin like the American?

A. It is rather smaller, has the head more broadened, the eyes smaller, a nail or claw upon each finger of the swimming paws, and its colour inclining to lilac.

Q. What is its food?

A. Like that of the other it is wholly vegetable, and found chiefly on the banks of the rivers.

Q. Where does the *dugong* inhabit.

A. The Indian Ocean, near the Malay peninsula, and its name is derived from the Malay language.

Q. Has it any peculiarities of character?

A. It has many. The upper lip hangs in flaps on each side of the mouth, and the lips are beset with horny processes, by means of which it is enabled to tear the sea-weed, on which it feeds.

Q. Is it a large animal?

A. It is not so large as the lamantin, the largest mentioned not being above eight feet in length.

Q. Is it used as food?

A. Yes, and considered a great delicacy by the eastern people. Its natural history is not, however, very clearly defined.

Q. Has the dugong tusks?

A. Yes, it has tusks of considerable size, of the finest ivory, of which the Malays and other eastern nations often make handles to their knives and daggers.

Q. Where is the *stellere* found?

A. In the northern parts of the Pacific Ocean, near the American shores, but its history is rather obscure.

Q. Is there any thing particular about it?

A. If the descriptions that have been given can be relied on, it is one of the most singular of animals, more especially in its covering.

Q. In what does that singularity consist?

A. It is said to be covered with a bark of tubes or fibres of a horny consistency, perpendicular to the skin, and forming a crust about an inch in thickness, which shields the animal with a natural coat of mail, which is flexible, and at the same time very difficult to be penetrated.

Q. Is there not said to be also some peculiarities in the teeth?

A. Yes, the teeth are said to consist of a plate in each jaw, which is not set into sockets in the jawbone, but fastened to it by an elastic matter. The fin of the tail is also said to be very broad, in the form of a crescent, and terminating in a horn or spine at each extremity.

Q. On what does it feed?

A. On sea-weeds; and it is not known to come on shore to graze like the lamantins.

Q. And those animals which you have mentioned do not belong to the cetacea, or whale tribe, poperly so called?

A. They do not. They are a peculiar race, and the most remarkable character that we know of in them is that they are the only aquatic animals that graze, and at the same time have the extremities fitted for swimming.

THE CETACEA PROPER.

Q. Are these an interesting order of animals?

A. They are. Some of them are the largest of living creatures, and among the most valuable to man. Hence they are sought for in the most dangerous seas, and by the longest voyages.

Q. Are they numerous?

A. They are; so much so that it is convenient to divide them into four sub-orders.

Q. What are the characters of these?

A. They are—

Edentatæ, or toothless whales.

Prædentatæ, or those that have teeth in the upper jaw only.

Subdentatæ, or those that have teeth in the lower jaw only; and,

Ambidentatæ, or those that have teeth in both jaws.

Q. Have the sub-orders all some common characters?

A. They have. The head is, generally speaking, exceedingly large, the eyes small, the neck short, the bones and muscles so covered with fat that the skeleton has little influence on the shape of the animal. The swimming paws contain the same number of bones as the human arm and hand, but they are concealed in the fin; and the hinder extremities are formed into a tail, the lobes of which are horizontal, and not vertical like those of fishes, and that tail is among the most powerful of animal instruments—the muscles that move it being of very great strength and peculiar structure, so that, though it does not lay hold, it is, in some of the species, as mobile as the proboscis of the elephant.

Q. In what does that appear?

A. In the tremendous blows which those whales that have no other weapons of defence, can strike with their tails. They can cut the strongest boat asunder, project it many feet into the air, or many fathoms under water, by what seems to them an ordinary effort.

Q. Does it appear also in the rate of their motion?

A. Yes, it is calculated that a whale can swim about five hundred miles in a day, not only without fatiguing itself, but absolutely enjoying itself, and eating its food as it dashes along.

Q. Is the tail which gives them so rapid a motion of large dimensions?

A. The breadth of that of the large ones across the lobes is about twenty feet.

Q. Are their senses acute?

A. Not generally. The eyes, though very perfect in their formation, are exceedingly small, and so situated in many of the species that they can hardly see before them, from the great quantity of fat or blubber with which they are covered; they do not appear to have much sense of touch; and their organs of hearing and smell are imperfect.

Q. What appears to be the use of the great quantity of fat or blubber?

A. It enables them to preserve the heat of their bodies in the cold seas through which they range.

Q. What is the food of whales?

A. That depends upon the structure of the teeth, and forms part of the particular history of the sub-orders.

1. *Edentatæ—toothless whales.*

Q. How are these divided?

A. Into two genera, *balænæ*, or those that have no fin on the back, and *balænoptera*, or those that have; and there are usually reckoned two species of each.

Q. Where do they inhabit?

A. Chiefly in the more northerly parts of the Atlantic, which are called the Greenland seas.

Q. Which are the species of *balænæ*?

A. *Balæna mysticetus*, the black whale, or common Greenland whale; and *balæna nord-caper*, the Iceland whale.

Q. What is the Greenland whale?

A. It is among the largest, and at the same time the most valuable of animals; many vessels are fitted out from the ports of Britain, and other countries, for the purpose of capturing it among the northern ice.

Q. What are its dimensions?

A. The ancients mention whales of the length of 00 or 900 feet; which are in all probability exaggerated; but in the early stages of the whale-fishery there are authenticated accounts of individuals 90 or 100 feet long.

Q. Are so large ones not met with now?

A. No. The largest that are now caught seldom measure more than sixty feet in length and forty round the body.

Q. What may be the cause?

A. The fishery has been pursued with so much ardour that the large ones have been captured and the numbers thinned.

Q. What is the colour of the whale?

A. The upper part is black, the under part, forward, is white, and backward, black; the skin, when the animal is healthy, is smooth and shining.

Q. What is the position of the whale on the water?

A. It swims with the body partially above the surface, but with the mouth under it; and it is said to sleep in the same position; but it often plunges to the bottom, although it soon comes up again to breathe.

Q. And can they breathe at the surface with the mouth under water?

A. They can. They have the nostrils so placed that while the mouth is wholly under water they can breathe with ease; and there is no immediate connection between the mouth and the windpipe.

Q. What is the character of the mouth?

A. It is immensely large,—so wide that several men could stand upright in it; and it is adapted for catching food without closing, as the mouths of most animals do.

Q. How is that effected?

A. There are plates of *baleen* or whalebone that descend at the sides, and rest upon the tongue, having the one edge furnished with a fringe. As the animal moves along open mouthed a current of water passes through these crevices, and with it the food, which is entangled as in a net.

Q. And does the water pass into the throat?

A. No. A portion, carrying with it the food, passes close to the entrance, is received into two cavities in the head; from which it is occasionally spouted with great force through the spiracles or blow holes.

Q. And the whale cannot bite them?

A. It cannot, nor swallow a substance much larger than a herring.

Q. Then the whale could not have swallowed Jonah?

A. The Greenland whale could not, and besides, it is not an inhabitant of the seas where he sailed; but there are other whales that can swallow objects much larger than a man.

Q. Are many parts of the whale useful?

A. The fat for oil; the whalebone of the mouth for many purposes; the jaw-bones and ribs, for timber in the northern countries; and the flesh in the same for food.

Q. What is the value of a whale?

A. A full-sized one is worth about a thousand pounds.

Q. How are whales captured?

A. They are struck with harpoons, which are barbed darts of iron to which lines are fastened; and when the animal is exhausted by running and plunging, which it often does to a very great depth, it is finished by spears and lances.

Q. What are the general characters of the Iceland whale?

A. It is grey and mottled, has more white on the under part, is more slender and active, more difficult to capture, and less valuable than the common whale.

Q. Which are the *balænoptera?*

A. The gibbar, or fin-fish, which has a remarkable fin on its back, and the beaked whale, which has a lengthened and pointed mouth. They have but little either of fat or of whalebone. The last species is never so long as thirty feet; and it is occasionally met with in the British seas.

2. *Prædentatæ—toothed above.*

Q. Which are these?

A. The narwhals, which are remarkable for a long twisted ivory tooth that projects from the upper jaw. They yield fine oil, and the tooth is valuable.

3. *Subdentatæ—toothed below.*

Q. Which are these?

A. The cachalots or spermaceti whales, of which the species are the great-headed, the blunt-headed, and the small-eyed.

Q. What are their characters?

A. They are larger than any of the common whales that are now met with, and they are very active and voracious, ranging over all seas, and feeding upon large fish. A shark twelve feet long has been found entire in the stomach of a cachalot. The blunt-headed is the most valuable inhabitant of the sea, for oil and for spermaceti.

Q. What is spermaceti?

A. Crystallized fat, but convertible into pure oil.

Q. In what seas is the spermaceti whale found?

A. Its range is much greater than that of the common whale, but it is chiefly fished for in the Pacific; and hence the fishing for it is called the South Sea fishing.

Q. And where is the common whale principally found?

A. In the northern parts of the Atlantic, close by the Polar ice, and often in the bays or openings of that ice.

Q. What appears to be their chief attraction to these places?

A. They are understood to be attracted by the *green* water, which is remarkable in that part of the ocean.

Q. To what is the green colour owing?

A. To the vast number of little animals of the melluscous or crusted tribes that are contained in it.

Q. And do these form the food of the whales?

A. It is understood that they do. They enter the vast opening of the mouth, as the animal swims along, and are entangled in the fringes of the *baleen*, or whalebone, as in a net.

Q. And do not the spermaceti whales feed in that manner?

A. No; they can bite or swallow large fishes; and all their habits are muchmore ferocious than those of the common whales.

Q. Is the capture of them attended with more danger?

A. Of course it is, though there are not so many dangers from the ice, as in the north, or Greenland fishing.

4. *Ambidentatæ—teeth in both jaws.*

Q. Which are the animals of that order?

A. The dolphin, of which there are several species; and the piked whale, which has the most singularly pointed and small teeth on the palate.

Q. Which are the dolphins?

A. 1. The porpoise, about six feet long, very thick, and destructive of salmon and other fish.

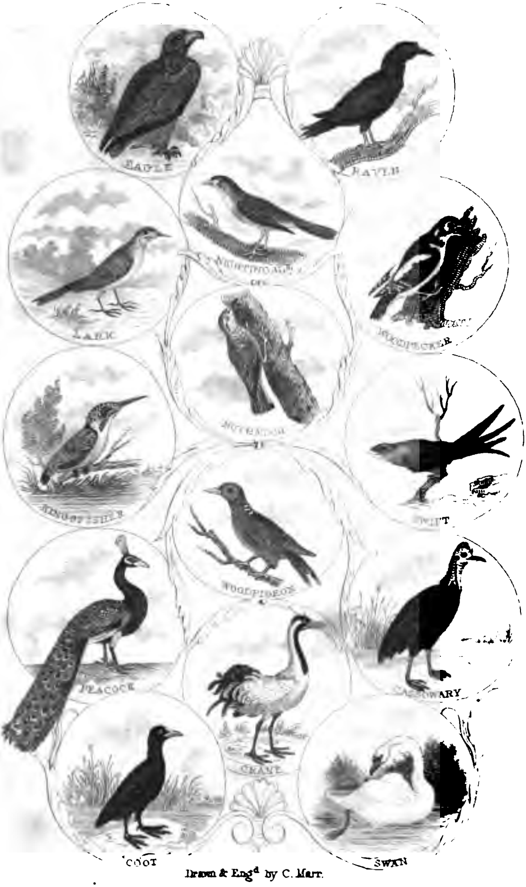
2. The dolphin, about ten feet long. It is not the dolphin of the Straits.

3. The grampus, a very voracious animal, about twenty-five feet long.

4. The sea-sword, about the same size, and yet more voracious. Attacks the common whale.

THE END.

LONDON:
HENRY BAYLIS, JOHNSON'S-COURT, FLEET-STREET.



Drawn & Engd by C. Marr.

PINNOCK'S

CATECHISM

OF

ZOOLOGY.

PART II.

BIRDS.

LONDON.
PRINTED FOR WHITTAKER TREACHER & C°
AVE MARIA LANE,
1831

CATECHISM OF ZOOLOGY.

PART II.

ORNITHOLOGY, OR BIRDS.

INTRODUCTION.

Q. WHAT is the Natural History of Birds called?

A. ORNITHOLOGY, from the Greek ʽΘρνιθὸ "of a bird," and λογος, "the explanation, or knowledge."

Q. What is a bird?

A. A warm-blooded animal, with a double heart, a back-bone, and four extremities like the mammalia; but walking only on the hinder extremities, having the fore ones adapted for motion through the air, the mouth with horny mandibles, the body covered with feathers, and produced from eggs.

Q. Is not flying a sufficient character for a bird?

A. No; there are some kinds of birds that cannot fly; and there are many insects, some reptiles, some mammalia, and even some fishes that can fly.

Q. Is there any thing curious about birds?

A. Yes; though their mouths be much less like the human mouth than the mouths of the mammalia are, they have natural songs, can be taught music, and even to speak.

Q. What are the principal divisions of the science of Ornithology?

A. The structure of birds, their habits, and the classification of them, and the description of the different species.

PART. I.—STRUCTURE OF BIRDS.

Q. What are the principal parts of which a bird is composed?

A. A skeleton of bones for the support of the other parts; muscles for motion; nerves for sensation; organs of the senses; a heart and circulating system; lungs for breathing; organs of nourishment; a skin, with its covering; and organs of defence or destruction.

SECT. I.—BONES OF BIRDS.

Q. Of what parts are the skeletons of birds composed?

A. They have some resemblance to those of the mammalia.

Q. In what do they differ?

A. One very remarkable difference is that the thick bones of birds are hollow, and have openings in them to admit air.

Q. Does not that weaken the bones?

A. No; they are stronger than if they had been solid with the same quantity of matter, especially if they be round or cylindrical; and they are much lighter, and consequently burden the bird less when it flies.

Q. But are not the sides of them liable to be squeezed together?

A. That is prevented by little ties of bone, that unite the sides across the opening; and these are nicely adapted to the pressure that the bone may have to bear.

Q. Is there any peculiarity in the back bone of birds?

A. Yes; the part forming the neck consists of more vertebræ, or joints, than in the mammalia; it admits of more motion, and the rest of the back-bone admits of less.

Q. Does that answer any important purpose to them?

A. It does. As the bird, whether walking or flying, is supported upon only one pair of its extremities—the feet on the earth, and the wings in the air—it has a firmer support to the pair of extremities that are in use; while the greater flexibility and length of the neck gives a greater range to the beak or bill.

Q. Is there any thing peculiar in the bones of the legs?

A. Yes; the bone that is usually called the thigh, is in reality the leg; and that which is usually called the leg, is the *tarsus*, or foot.

Q. The divided part of the foot is then really the toes?

A. Of course it is.

Q. What is remarkable in the head of birds?

A. The skull is small; the rudiments of jaw-bones are cased with horn; there are no teeth; and the mandibles are connected by a peculiar bone, which allows of great opening to the bill or beak.

Q. Are there any peculiarities in the bones of the under part of a bird?

A. There are, in the merry-thought, which separates the clavicles, or collar-bones; in the breastbone; and in the situation of the ribs.

Q. What is peculiar in the merry-thought?

A. In birds of powerful wing and rapid flight—as in eagles—it is a strong circular arch; while in feebler birds it is angular and weak.

Q. What is peculiar in the breast-bone?

A. It is very much extended, and has a keel in the middle, for supporting the large muscles on the breast that moves the wings.

Q. Is there any difference in the keel?

A. Birds that use their wings much, have it very deep, and it deepens towards the front; while in those that fly little, or creep along the bark of trees and other surfaces, have the keel flat.

Q. What is there with regard to the ribs?

A. In birds of flight, the ribs are thrown forward; while in water-birds they reach back, by angular bendings, almost to the tail.

Q. What is the object of these differences?

A. In birds of rapid flight, the throwing forward of the bones gives them more strength against the air, as they cleave their way through it; and the backward ribs protect the hinder parts of water-fowl from the pressure of the water.

Q. Is there any other thing peculiar in the skeletons of birds?

A. Yes; the most powerful birds have the largest and strongest bones, especially the breast-bone and the extremities. An owl and a hawk may appear equally large, and weigh the same, and yet the breast-bone of the owl may not be one-fourth the size of that of the hawk.

SECT. II.—MUSCLES OF BIRDS.

Q. What are the characters of the muscles of birds?

A. They contain less blood in their substance, and endure longer fatigue than those of the mammalia; but they vary very much with the different species.

Q. What are some of the leading differences?

A. Birds that continue much and long upon the wing, have the muscles on the breast large, in proportion to those on the hinder extremities; those which run, but do not fly, have the ones behind largest; and those that spend equal portions of their time in the air, and on the wing, and on the ground, have them nearly alike, or of equal strength.

Q. Which muscles of the wings are, in general, the largest?

A. Those that move the whole—that is, those which are on the breast.

Q. Are there any cases in which the muscles of the other parts of the wing are more than usually strong?

A. Yes; birds that strike with the wing have the particular muscles very strong.

Q. What are the particular portions of the wing?

A. The wing is in its bones a sort of arm and hand, although these be enclosed in one skin.

Q. What parts of the wing bear this analogy?

A. The shoulder-bones, which are imbedded in the muscles that raise the wing; the *humerus,* which answers to the arm above the elbow, and has the most powerful motion; then there is a fore-arm of two bones, a wrist, a hand, and two fingers, the one consisting of two sets of bones, and the other of one.

Q. Is there any thing resembling a thumb in the wing of a bird?

A. Yes, there is a sort of thumb that supports the bastard-wing; and in some birds there is a sort of nail or claw upon it.

Q. Are there any differences in the muscular structures of the legs of birds?

A. Yes, to answer three functions, which birds perform with their feet.

Q. What are those three functions?

A. They may be described as, simply walking and running; clutching or perching, by drawing the toes together; and swimming, by working the leg much in the same manner as an oar, expanding the toes when the foot strikes the water, and contracting them when the foot is drawn through the water.

Q. Is there not a fourth function?

A. Hopping may be considered as a sort of fourth one.

Q. How is it performed?

A. The body of the bird is thrown upwards and forwards, by a sudden contraction of the toes; and many birds, when they take wing, perform an operation of that kind.

Q. What is requisite for the performance of that operation?

A. The bird must have a back toe of considerable power; a swimming bird could not hop.

Q. Then what does the term "swan-hopping" mean?

A. It means "swan-*upping*"—that is, taking swans up.

Q. In simple walking, what muscles must be the strongest?

A. Those that move the foot-bone of the leg.

Q. And in a clutching-foot—such as that of a hawk or eagle?

A. Those that draw the claws together, and those that extend the leg, as the feet of these birds strike as well as clutch.

Q. Which are the most powerful muscles in a perching-foot—such as that of a parrot?

A. Those that draw the toes together; the ones that spread the toes, and move the feet in walking, are very weak, and therefore such birds walk with difficulty.

Q. Where are the muscles of the clutching-feet seated?

A. They are seated on the *tibia*, or leg-bone?

Q. And is there any greater protection to them than to the legs of other birds?

A. They are, generally speaking, better defended by feathers.

SECT. III.—SENSES OF BIRDS.

Q. Have birds five senses, the same as the mammalia?

A. It is understood that they have in all cases, though the sense of taste is probably not very delicate, and that of touch is limited.

Q. By what is the sense of touch limited?

A. By the body being covered with feathers, and the legs by horny plates.

Q. But may they not feel in the feathers?

A. Not in the feathers, because they are not furnished with nerves; but they may feel through the medium of the feathers, just as man and other mammalia feel through the medium of the hair.

Q. What species of feeling is that?

A. Tickling, if the application be gentle; and pain, if it be severe.

Q. How does it differ from touch?

A. The mere presence of the object is perceived, but not its kind of surface or texture.

Q. Are there no parts of birds that have the sense of touch?

A. The margins of ducks' bills, and some other parts of birds, which have neither feathers nor scales, are understood to have a very acute feeling of touch.

Q. What is the use of the keen sense of touch in those parts?

A. In the duck it enables the bird, when dabbling in muddy water, to find that food which no other sense could discover under the circumstances.

Q. Upon what senses have birds the greatest dependence?

A. Upon the senses of sight, hearing, and smell.

Q. Are those understood to be more acute than the same senses in the mammalia?

A. They are.

Q. Which birds are supposed to have the most acute sense of sight?

A. Birds of prey; but the qualities of the sight vary, from the eagles down to the owls.

Q. What is the remarkable character of sight in the eagles?

A. The distance at which they can see their prey. An eagle will *stoop* with unerring certainty upon a small quadruped or bird, though not in motion, and very like the earth in colour, when the eagle is so high as barely to be visible.

Q. What is the purpose of that great range of vision in eagles?

A. They frequent lonely places, in which prey is not very abundant, and thus they require to take in a great extent of space.

Q. Have they any particular structure of the eye for that purpose?

A. The eye stands out upon a socket of bone: the crystalline lens* has great power, and the focal length can be much varied.

Q. What is the change in the other birds of prey?

A. As their flight is lower, their eyes have more magnifying power, but they see to a less distance.

Q. What is the difference in the lenses of the eyes?

A. They become more convex, or thicker in the middle in proportion to the size.

Q. Which have the eyes of the greatest magnifying power?

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* See Catechism of Optics.

A. The owls, and next to them the twilight hawks.

Q. Is there any other peculiarity in the eyes of owls?

A. They admit so much light, and the light has so powerful an effect upon them, that they see with difficulty during the day.

Q. Have not birds a peculiar kind of eyelid?

A. They have a curtain that sweeps over the whole eye in an instant, while the common eyelids remain at rest; and that curtain is called the *nictitating* membrane.

Q. What is the meaning of nictitating?

A. Winking.

Q. Are the organs of hearing as perfect in birds as in the mammalia?

A. They have no external ears, because these would both impede their flight and make a noise in the wind; but many of them have peculiar feathers which probably assist them in hearing.

Q. In which birds are these most conspicuous?

A. They are most so in owls.

Q. What purpose do they apparently serve in them?

A. They serve two—prevent the owl from making a noise itself, and enable it to hear its prey in the dark.

Q. Which birds have the keenest sense of smell?

A. Vultures, and other birds that feed upon putrid substances.

Q. And do these far exceed other animals in that sense?

A. They do. The distances over which some of them will fly to a putrid carcase are almost incredible.

SECTION IV.—CIRCULATION AND RESPIRATION OF BIRDS.

Q. Does the circulation of birds resemble that of the mammalia?

A. In most respects it does.

Q. In what do they differ?

A. The principal difference is in the heart, which has a greater power of sending the blood to the lungs.

Q. Is the breathing of birds like that of the mammalia?

A. They breathe by lungs as the mammalia do; but a bird is in some measure lungs all over.

Q. How do their lungs differ from those of the mammalia?

A. They are of stronger substance, and have the cells larger; they are also connected with cells within the animals, and those cells extend to the bones, and even to the feathers.

Q. Do those cavities and air-vessels communicate with the lungs?

A. They do; and there have been instances of birds breathing through them when the windpipe was tied.

Q. What purposes do these serve?

A. They furnish a supply of air when the motion of the bird is so rapid that it could not breathe wholly by the windpipe, as is the case with quadrupeds; and thus birds do not lose wind.

Q. Any other purpose?

A. Yes. The air in those tubes and cavities has access to the blood in other vessels besides those of the lungs; and thus the action of the air is extended over the system, and the fatigue of the bird is, in consequence, chiefly confined to muscular exhaustion.

Q. Is there any thing particular in the windpipe of birds?

A. Yes. The rings of cartilege are more complete, and in many of the species there are enlargements and convolutions in the windpipe.

Q. What purposes do these serve?

A. They partly increase the internal supply of air, and partly contribute to the voice of the birds.

Q. Is there any structure of the ordinary openings for breathing that appear to render those internal supplies of air necessary?

A. There are. The openings of the nostrils are slits, which the bird can shut when necessary.

Q. Is there any necessity for shutting them?

A. Yes; birds have no teeth, and thus they can only bruise their food, and many of them swallow it entire; and thus the apertures of respiration have to be shut in the act of swallowing.

SECTION V.—FOOD AND DIGESTION OF BIRDS.

Q. What forms the food of birds?

A. A variety of substances, animal and vegetable.

Q. What is the form of the stomach?

A. In many birds there is an enlargement of the gullet, which forms the craw or crop—a receptacle for a greater quantity of food than the digesting stomach can act upon at one time.

Q. And in addition to that?

A. Those birds that feed upon seeds, buds, and other vegetable substances which are not easily digested, have a very thick and strong muscular gizzard, in which mechanical action assists the *gastric* or digestive juice; and those that feed upon insects or animal food have a membranous stomach.

Section VI.—Covering of Birds.

Q. What are the coverings of birds?

A. The proper coverings are feathers.

Q. Are not particular names given to the feathers?

A. Yes, from the places on which they grow, and the purposes which they serve.

Q. What are the distinctions in the wings?

A. The most remarkable ones are the following:—

1. The primaries, or quills, which form the extremity of the wings, and grow from the tip to the first moveable joint.
2. The secondaries, from the next joint, and which cover the primaries for a portion of their length.
3. The tertiaries, which grow from the *humerus*.

After these there are the upper and under coverts, or covers, which gradually diminish in size as they are farther from the quills.

Q. Is there any advantage in this arrangement?

A. The wing is made strong as well as light, as each overlapping feather supports a portion of the one under it, just as the plates in a coach-spring support each other.

Q. Is there any peculiar adaptation in the upper side being better supported than the under one?

A. Yes; the greatest action being to pull the wing downwards, the resistance on the upper side prevents the wing from bending.

Q. Is the action increased by any other peculiarity in the form?

A. Yes, the curvature of the wing—the hollowness in the under side, enables it to take a better hold of the air.

Q. Is there any other appendage to the wing?

A. Yes; between the primary and secondary quills there is a bunch of stiff feathers that form the winglet or bastard wing.

Q. Are names given to the feathers of the tail?

A. Yes; the largest ones are called feathers, and there are upper and under tail covers.

Q. On what part of the body are the scapulars?

A. On the shoulders and sides of the back.

Q. Do not birds dress their feathers?

A. They have an apparatus near the insertion of the tail, from which they obtain oil to dress, or "preen" their feathers, and protect them from rain.

Q. What birds are best protected in that way?

A. Water-birds, upon which the water has little effect.

Q. Are there not some birds that have their feathers powdered?

A. Wood-pigeons, and some other species, have powder on the feathers under the wings.

Q. Have not some birds two kinds of feathers?

A. Water-birds have down as well as feathers; and there are some that have whiskers, and others hair upon their bodies.

Q. Are there not some differences in the texture of the feathers of birds?

A. Yes. Birds that fly high and rapidly have the webs of their feathers strong to the extremity; but there are other birds that have a fringe of remarkably delicate fibres on the edge of the web.

Q. In what particular class of birds is that most remarkable?

A. In the owls.

Q. What purpose does it serve in them?

A. It enables them to glide along in perfect silence. An owl will pass close to one without being heard, and brush through the boughs of a forest without even disturbing the leaves: thus it is enabled to steal on its prey without exciting the least alarm, and the unsuspecting mouse is seized at the very entrance of that hole, in which, had the least sound been made, it would have found perfect safety.

Q. Are there any parts of birds in which the skin is destitute of feathers?

A. Many birds have a naked *cere* at the base of the beak, or bill, and in some it extends as far as the eyes, in which case it is termed a lore; and some have the head and a portion of the neck wholly or partially naked.

SECTION VII.—FEET OF BIRDS.

Q. Have the feet of birds many differences of character?

A. They have; and each kind of foot is beautifully adapted to the habits of the bird.

Q. Mention some of them.

A. Eagles, hawks, and other birds that kill their prey, have the legs short and strong; and the hind toe and inner front one come together with great force, and plunge the claws, which are strong and crooked, deep into the body of the prey.

Q. What is a second character?

A. Birds which live wholly or chiefly in trees have only two toes to the front, the outer one being either wanting or turned backwards. These birds walk very awkwardly on a plane surface.

Q. What is a third character?

A. Birds that have to rise suddenly from the surface of the grass have the toes and claws, especially the hind one, very long; and by the rapid compression of these together, they throw themselves so high that the wings are not obstructed by the grass.

Q. What is a fourth character?

A. Birds which scratch the ground for their food, and consequently run in places that are bare, have the claws and hind toe short; and in many cases the outer and middle toes are united as far as the first joint.

Q. Are there not some peculiar characters in the feet of aquatic or water birds?

A. Yes, and there are varieties of them, according to the habits of the bird.

Q. Mention some of them.

A. Birds that do not swim, but wade in shallow water for their prey, have stilts, that is very long legs; and the horny plates with which these are covered are so close as to be a complete defence against the water.

Q. And is there any corresponding adaptation of the neck and bill?

A. Yes; the neck is always long, and remarkable for the rapidity and variety of its motions.

Q. Is there any thing peculiar in the bill of such birds?

A. Yes, if the bird is to catch swimming prey, such as fishes, the bill is pointed, and the edges of the mandibles are toothed or notched, so that they may retain the prey.

Q. If the bird find its food by dabbling in the mud?

A. The bill is flattened like that of a duck, and has a soft margin or covering, more or less sensitive.

Q. What are the characters of the feet of those birds that swim in the water?

A. Some of them are palmated, or have the whole of the toes connected by a membranous web; some are only partially palmated; and others, again, have the toes separated, but the sides *pinnated* or feathered by membranous lobes.

PART II.—HABITS OF BIRDS.

Q. Which are the principal points in the outline of the habits of birds?

A. They are so many that it is not very easy to classify them; but the following are some of the most simple and apparent:—

Locality and range—flocking—migration—mating—treatment of their young—moulting—seasonal changes.

SECTION I.—LOCALITY AND RANGE OF BIRDS.

Q. What do you mean by the locality of birds?

A. The places, whether as to the latitude or the different kind of surface, on which they are chiefly to be found.

Q. What do you mean by the range?

A. The extent or change of country that they pass over, when that does not appear to be influenced by the seasons.

Q. What is the chief distinction as to locality?

A. The most obvious is sea-birds, water-birds, and land-birds.

Q. Are those equally proportioned to each other all over the world?

A. No. Land-birds are most numerous in the warm latitudes, and sea-birds in the cold; while in temperate countries the numbers are more equalized.

Q. Has the distribution in latitude any influence upon the colours of birds?

A. Upon sea-birds its influence is not very remarkable, as the different latitudes of the sea have not the same differences of temperature as those of the land; but in the land-birds the influence is very remarkable.

Q. What is most conspicuous in it?

A. The land-birds of the tropical countries present the most brilliant colours that are to be met with any where in nature. Reds, greens, blues, yellows, in short, all colours, of the most intense depth, and varying in tint as seen in different lights, with a play of brilliance that no art can imitate.

Q. And do the colours become pale as the climate becomes colder?

A. They do, till the birds at last display only the grey, brown, black and white colours of the barren lands of which they are inhabitants.

Q. Does there appear any adaptation or design in that, or is it merely the effect of the different degrees of solar heat.

A. There is no part of nature in which design is not perfectly apparent; neither is there any circumstance even so simple as that of a tint of colour, that has not its use, if we were sufficiently wise for finding it out.

Q. Which is the most apparent use of those varieties of colour?

A. To protect the birds from their enemies.

Q. How does it accomplish that?

A. The trees of the tropical forests, in which the parrots and other birds of brilliant plumage reside, are constantly green with leaves; they have generally flowers and fruit upon them; and they are festooned with climbing plants that display very splendid colours.

Q. Have we the same adaptations in the colours of birds in this country?

A. We have to a considerable extent. The birds resemble in colour those substances or surfaces on which they are generally found.

Q. How does that apply in the case of rooks, which are black?

A. It not only contributes to their safety, but enables them to perform a very useful operation to the farmer, by immediately following the plough, and destroying the larvæ of those insects, which, if they remained in the ground, would destroy the young plants of corn.

Q. What are the several classes of land-birds, considered with relation to their dwellings?

A. House-birds, such as sparrows and swallows, which reside near the habitations of man, form one class.

Q. What form another?

A. Garden-birds, which change with the seasons, eat insects, and sometimes fruits and buds, and also the seeds that are newly sown.

Q. Whether do these do more good or harm?

A. It is not very easy to say; but probably from the vast number of insects that they destroy, and which, if left alone, would eat up the whole vegetation, the good that they do is greater than the harm.

Q. What form another local class?

A. Field-birds, or those that are chiefly found in cultivated grounds, larks, partridges, and many others.

Q. What form another class?

A. Hedge-birds, or those that nestle in hedges; and these are nearly allied to coppice-birds.

Q. Are there any forest-birds?

A. Yes. Rooks, woodpeckers, pigeons, and many others. There are also heath-birds, mountain-birds, and rock-birds. Eagles and ravens are among the latter; the first in mountain rocks, and the last in those that are less elevated.

Q. What are the distinctions of water-birds as depending on locality?

A. *Pelagic* birds, or those that are found on the open seas; they are generally birds of powerful wing, and can sleep on the water. They are found in the tropical seas often at a great distance from the land.

Q. What form a second division?

A. *Littoral* or shore-birds, that are not generally found very far out at sea, and generally sleep on the land. Many of them are birds of powerful wing, and others cannot fly at all, but use the rudiments of wings that they have as a sort of oars.

Q. Is there any other kind connected with the sea?

A. Yes. There are beach-birds, that cannot swim, but can run with great rapidity along the sands.

Q. Is there any thing peculiar about them?

A. As they pick their food out of the margin of the water they have generally very long bills.

Q. What is the distinction between beak and bill, as applied to the mandibles of a bird?

A. When adapted for tearing, with the upper mandible crooked downwards at the point, it is a beak; in all other cases it is a bill.

Q. Which are the fresh-water birds?

A. They are not so distinct as the sea ones; but there are marsh-birds, such as snipes, swimming-birds, wading-birds, bank-birds, and skimming-birds, that catch insects over the surface.

Q. Do these birds vary much in range?

A. They do. The sparrow continues near the same cottage, the magpie near the same tree, the partridge in the same field, and though the rook takes daily journeys of considerable length, she always returns to nestle in the same rookery, or even in the same tree. The eagle, too, remains in the same rock for centuries, and keeps the moors and valleys around her as her own preserve.

Q. Have any others a wider range?

A. There are many birds that summer in the inland and winter on the coasts; and some sea-birds nestle by thousands on the banks of lakes, many miles from their natural element.

SECTION II.—FLOCKING OF BIRDS.

Q. What is meant by the flocking of birds?

A. Their associating together in great numbers at certain times of the year.

Q. At what seasons of the year do the flockings take place?

A. There are partial flockings in the spring, but the principal ones are in the end of autumn and the early part of winter, when the fields are clear of herbage, and the seeds that have been shaken from the plants can be seen.

Q. What is the purpose of the flocking of birds?

A. It is not easy to say, unless it be that they are all attracted to the place where they are the most likely to find food.

Q. Is it not in some way connected with their migration?

A. In all probability it is; and yet rooks, which do not migrate, flock as conspicuously as any class whatever.

SECTION III.—MIGRATION OF BIRDS.

Q. What do you mean by the migration of birds?

A. Their shifting from one country to another, or from one place of the same country to another that is at a considerable distance, and in the same direction in which those that take longer flights migrate.

Q. What is the direction in which birds migrate?

A. From south to north, or from north to south.

Q. Does that migration enable us to divide birds into seasonal classes?

A. It does; and at any one place we have three classes—constant residents, summer migrants, and winter migrants, besides occasional stragglers, which belong to the migratory birds of other longitudes.

Q. Is any common name given to the two classes of migrants?

A. They are called birds of passage.

Q. At what periods do the summer birds of passage come?

A. They come at some period of the spring or early summer; and take their departure in autumn; but they come and depart at different times according to the distances that they have to fly.

Q. Are they all birds of the same natural class?

A. No. Some of them are land-birds, and some water-birds; some of them feed on grain, some on sects, and some on fish.

Q. For what purpose do they come to us in the spring and summer?

A. For the purpose of building their nests, and aring their young; and many of them give us usic the while.

Q. Is it the warmth that sends them to us?

A. That cannot be, as they come from countries t are warmer than our own.

Q. What then can impel them?

A. The time at which they come to us, is that at which there is the greatest quantity of food for them; and the summer days are longer with us than with the people farther to the south, so that they have more time to gather food for their little ones.

Q. Do they arrive in all parts of Britain at the same time?

A. No. They arrive sooner in the southern parts.

Q. From what distances do they come?

A. Many of them are understood to come from Africa.

Q. Have we any summer visitants from America?

A. Not any summer birds; the difference of longitude in the regions of the equator is too wide for that.

Q. Then the time during which the summer birds of passage remain with us is a time of labour with them?

A. The first part of it is a time of severe labour, as they have their nests to build, one has to find the food of two, during the greater part of the incubation or sitting on the eggs; and the old birds have to find their own food, and also that of the broods, until these are fledged and able to provide for themselves.

Q. Do the parent birds shew any signs of the effects of this severe labour?

A. They do; for by the time that they have only themselves o provide for, their plumage is disordered and torn.

Q. Have they any means of repairing those injuries?

A. They have. They retire into those places where their food is most abundant, and change their feathers wholly or partially, thus becoming new winged for their flight.

Q. From whence do the winter birds of passage come?

A. From regions that are farther to the north; and they are impelled southward by the same influence of the cold that drives the summer visitants from our shores.

Q. Are the winter ones as varied in character as those of summer?

A. They are not. The land-birds of the cold latitudes are comparatively few; and thus our winter visitants are for the most part water-birds.

Q. Are there any exceptions?

A. The snow-bunting, which is one of the most northerly inhabitants of the land, its nesting-place being in Lapland and the dreary rocks still farther to the north.

Q. What places do the other winter birds frequent?

A. The shores of the sea, the banks of lakes and rivers, and any open marshy or watery places.

Q. Have we not some winter birds that migrate to a considerable distance within the country?

A. Yes. The wild swans and geese that are found nestling in vast numbers by the lakes and pools in the north, during the summer, scatter themselves all over the country during the winter, and make their journeys farther to the south, the more severe that the weather is.

Q. Is there any remarkable difference in the coming and going of those birds?

A. Yes, the winter ones, with the exception of stragglers, come in flocks of greater or smaller number, according to the habits of the birds.

Q. And how do they depart?

A. They depart singly, as there is no flocking of them together, as in the other case mentioned.

Q. What is the case with the summer birds?

A. They come singly, flock partially before they pair, and collect in large flocks before they leave the country.

Q. Are there any exceptions?

A. There are, and cuckoos may be considered as an instance of them; they come into the country, and go out of it nobody knows how; but they are retiring birds at all times.

Q. What is the object of the flocking of the summer birds of passage?

A. As the flocking is always after the young broods are reared, it may be that it is to enable the young to find their way to the winter retreat; although there is not much reason to suppose that birds stand in need of any such pilotage.

Q. Why?

A. We have few, if any, well authenticated instances of animals standing in need of schooling from other animals; but very many in which all the propensities of the kind of animal have been developed without any schooling.

Q. You mentioned that there are more stragglers or occasional visitants among the birds that migrate southward, than among those that migrate northward: what is the reason?

A. The degrees of longitude are so short in the high latitudes, that a very little deviation to the east or the west, may waft a bird of Russia or Greenland, that is, a bird which has passed the summer in either of those countries, to England.

Q. Is there any other circumstance that would facilitate a communion of birds in the northern regions of the world?

A. The ice in the polar seas generally, and the short distance from Siberia to America, may enable grouse and other birds not capable of very long flights, to pass from the one continent to the other.

SECTION IV.—NESTING AND TREATMENT OF THEIR YOUNG.

Q. What are the situations of the nests of birds?

A. There is one peculiarity worth notice, and that is, that the care bestowed upon the safe place and neat structure of the nest, is always in proportion to the length of time that the young birds are to remain in it.

Q. What birds remain longest in the nest?

A. Those of course that are the worst adapted for walking on the ground, and especially those that have not perching feet, and which in consequence spend the greatest part of their time upon the wing.

Q. Mention some instances.

A. Plovers, partridges, and other birds that run about the moment that they are out of the shell, make hardly any nest at all; and the same may be said of some of the water-fowl. Common poultry do make a sort of nest, but a very rude one. Others are gradually more careful in the formation of the nest, as the young birds have to depend more upon their wings, until we come to the swallows, and some analogous tribes, that actually build houses.

Q. What is the reason?

A. Adaptation to the habits of the bird.

Q. In what way?

A. The feet of all birds are formed and entire at the time they come out of the shell; but they have no feathers; and therefore birds that constantly use their wings must remain in the nest till the feathers upon which their flight depends be grown; and the larger and stronger the feather is, it must take the longer time in growing.

Q. Have birds any affection for their young?

A. Nature is always true to her purpose; and there are no young of animals that need any assistance and protection from their parents, to which there is any fear of disappointment from the want of affection in the parent.

Q. Do all birds shew their affection in the same way?

A. There is rather a marked distinction, founded upon the difference that has been mentioned, in the lengths of time that the young birds remain in the nest.

Q. What is that?

A. The runners and the swimmers that almost immediately take their own food need only protection, and to be led to the place where it is; and we have remarkable instances of this in hens and geese. All the other land-birds that are fed in the nest, and are about able to provide for and protect themselves as soon as they leave it, or its immediate vicinity, have no need of the attention of their parents afterwards, and thus the affection between them ceases.

Q. Have we any remarkable instance of that?

A. The eagle will fight desperately and almost to the death for her eaglets while they are in the nest; but as soon as they have got their wings, and are able to kill their own prey, they are driven from their mother's eyrie, and not suffered again to approach it.

Q. Is it different with other birds?

A. Yes; the hen continues to watch over her brood; and partridges and grouse remain in family coveys till the winter.

SECTION V.—MOULTING OF BIRDS.

Q. You have mentioned that the moulting of birds is the seasonal change of the feathers?

A. Yes, rather the whole or the partial change of them.

Q. How long does a feather last?

A. Only one year in the natural way; and if it be broken or destroyed by accident it is replaced sooner.

Q. Are there then two moults in the year?

A. There are a great one and a partial one—the one in the spring and the other in the autumn, or rather the end of summer.

Q. Which of them is the great one?

A. That depends something on the habits of the bird. They may be described as in general having the great moult, and the new coat of feathers, just before the commencement of their labours in that part of the year when they are most scarce.

Q. And does that vary with the habits of the birds?

A. Yes, the resident birds have the hardest labour from the beginning of the winter to the time that their broods are reared, and hence they have their great moult in the autumn; winter migrants have it in the autumn, also, in those countries where they breed; but summer migrants have it in the spring, as there is no time for a moult between their arrival in this country and that of pairing.

Q. Then the swallow cannot pass the winter at the bottoms of pools, as is vulgarly said?

A. That is impossible, as the bird could not possibly moult there.

Q. What is the probable origin of this absurdity?

A. Swallows, the instant that they arrive, resort to the waters in quest of the early water-flies; and their passage to those places is not observed.

Q. Can any judgment be formed of the time of moulting in birds in a state of nature, from the moulting of those that are confined or domesticated?

A. No correct judgment can be so formed, as the very climate and seasons are changed to birds kept in the house.

Q. Then artificial collections are not places in which to study the habits of animals?

A. They are not. Only the appearance can be noticed then, and even these are liable to be changed.

SECTION VI.—SEASONAL CHANGES OF BIRDS.

Q. What are the most remarkable seasonal changes to which birds are subject?

A. Seasonal changes of colour are the ones for which they are most remarkable, and the ones that are most perplexing to naturalists.

Q. Do the changes take place at the same times of the year?

A. The changes are always gradual; and they take place sooner or later, and are completed in longer or shorter times, according to the weather.

Q. Does any other change accompany the change of colour?

A. The winter change is accompanied by an increase of down among the feathers, and the summer by a diminution.

Q. What is the general change of colour?

A. In cold places all birds become lighter in their tints, and some of them white altogether during the winter months.

Q. What bird becomes white?

A. The ptarmigan, or white grouse, which is ashen grey, with dark spots, in the summer, is white in the winter; and the Alpine sandpiper, which is mottled black and brownish red in summer, is of a pale ashen colour in winter.

Q. Do similar changes happen to water-birds?

A. The black guillemot becomes white with ash-coloured spots in the winter; and the black-headed gull gets a white head.

Q. Do those seasonal changes answer any useful purpose?

A. They answer a most important one: both the down and the lighter colour tend to make the birds warmer in the winter; and the darker colours and absence of the down keep them cool in the summer.

Q. Are those seasonal changes necessary for the water-birds?

A. They are; as they have often to be in shallow water, and melted snow and ice, which are nearly as cold as the temperature of freezing.

SECTION VII.—USES OF BIRDS.

Q. What are the uses of birds?

A. They are very many—in the economy of nature, and also to man. Some of them are scavengers, and clear the earth of substances that would otherwise be offensive; others protect vegetation from insects; many of them furnish us with wholesome and nutritious food, in their flesh and in their eggs; some supply us with our softest pillows, and others have feathers which nobles and kings are proud to wear.

Q. Have they any other uses?

A. The songs of the birds, as they cheer each other in the labour of preparing cradles for their young, give to the season of spring half its delights; the raven in the storm, the eagle floating over a mountain top—any situation in which we can see almost any bird, imparts pleasure, if that situation be in accordance with its natural habits.

Q. Any farther use?

A. The coming and departing of birds, their silence and their breaking into song, the times at which they separate and at which they flock together, are all so many points in the kalendar of nature, far more true to the state of the season than any which man can contrive.

Q. Any thing further still?

A. The structure of birds; the elegance of their general forms, the admirable skill with which the several parts of them are adapted to the functions which they have to perform; so that nothing either of matter or of moving power may be wanting or wasted: all these, with the reflections to which they give rise, make the study of birds one of the most delightful and the most instructive about which the thoughts of man can be occupied.

PART III.—CLASSIFICATION OF BIRDS.

[*Note.*—In the whole space to which this little work is restricted, it would be impossible to give an enumeration of the genera even in one order of birds; and the proper description of a few species would also occupy the whole of it. All, therefore, that can be done *usefully*, is to give some short account of the natural orders.]

Q. How are birds classified?

A. There has never yet been a perfectly satisfactory classification; but that which can best convey some general notion of them is a natural system, founded partly upon their appearance, and partly on their habits.

Q. What part of their appearance is best for that purpose?

A. The beaks and feet. As these are the means by which the bird gets its food, they are better adapted for classification than any other of the external characters.

Q. How many orders may be formed in this way?

A. About fourteen.

Q. What is the first order?

A. Accipitrous Birds.

Q. What does that mean?

A. Hawks, or plunderers; those birds which kill, or live wholly upon flesh, the same as birds of prey.

Q. What is the second order?

A. Omnivorous Birds; or those that eat flesh, and do not hesitate to kill small animals, but which can also eat vegetables when animal food is not to be found.

Q. What is the third order?

A. Insectivorous Birds, or those that feed chiefly upon insects, though some of them kill small birds.

Q. What is the fourth order?

A. Granivorous Birds, or those that eat seeds; but many of them also eat worms and other substances.

Q. What is the fifth order?

A. Zygodactylous Birds, or those that are yoke-footed, or have the toes opposed, two and two, to each other.

Q. What is the sixth order?

A. Anisodactylous Birds, or those that have climbing-feet.

Q. What is the seventh order?

A. Alcyonian Birds, or those that in their habits resemble the kingsfisher.

Q. What is the eighth order?

A. Chelidonian Birds, or those that have the habits of swallows.

Q. What is the ninth order?

A. Colombian Birds, or pigeons.

Q. What is the tenth order?

A. GALLINACEOUS BIRDS, or fowls.

Q. What is the eleventh order?

A. CURSORES, or running-birds.

Q. What is the twelfth order?

A. GRALLÆ, or wading-birds—literally, birds on stilts.

Q. What is the thirteenth order?

A. PINNATIFID, or fin-footed birds.

Q. What is the fourteenth order?

A. PALMIPED, or web-footed birds.

Q. Is there any thing like a regular gradation in these orders?

A. There is a very marked gradation. The eagle, the first of the first order, is the loftiest inhabitant of the air, and the bird of most powerful wing; while the penguin, the last of the last order, is mostly confined to the water, is fat, unwieldy, and sluggish in its motions, and incapable of flight.

ORDER I.—ACCIPITROUS BIRDS.

Q. What birds belong to that order?

A. Eagles, hawks, vultures, kites, buzzards, and owls, which form a sort of descending scale from the eagle to the owl—the eagle hunting for her prey in the clearest weather, and from great elevation; and the owl flying low, softly, and in the dark.

Q. What are their common characters?

A. Strong, crooked beaks, and talons or claws; ferocious dispositions, fondness for slaughter and raw flesh; a disposition to avoid the habitations of men; no association but of the pair with each other—but that is constant, and for life.

Q. Are these destroyers of any use?

A. No question but they are. The owls are very useful to the farmer in the field, and even in the barn; the harriers, and kites, and hawks reduce the numbers of birds and small quadrupeds; the vultures consume carrion; and the eagles also perform their function in nature.

Q. But are not the birds of prey cruel?

A. Not more so than man when he kills a sheep, or that sheep when it bites grass. The productions of nature are all subservient to each other, and the supply of each is proportioned to the demand that there is for it.

Q. What do you mean?

A. Were it not for the birds of prey, those animals upon which they live would multiply so fast, that probably more would die of hunger in the winter than are killed all the year round.

Q. Whether is the male or the female of birds of prey the more powerful?

A. The female is always the larger and more powerful bird.

Q. Are the genera and species numerous?

A. There are a good many of them, but from the differences between the two sexes, and between the young birds and the old, and also from the places that they inhabit, they are not very clearly defined.

ORDER II.—OMNIVOROUS BIRDS.

Q. What birds belong to that order?

A. Crows, jays, magpies, choughs, mandrills, starlings, birds of paradise, and many others.

Q. What are their characters?

A. Their bills are nearly straight and pointed, very sharp at the edges, and generally at the point; they have four toes on the feet, and many of them hop upon both legs.

Q. Are they numerous?

A. Some of the species are very much so; and some of them, as the raven and the carrion-crow, are found in all parts of the world.

Q. On what do they feed?

A. Their taste is very general; and most of them are very voracious.

Q. Are they tameable?

A. Many of them are, and not a few may be taught to articulate words.

ORDER III.—INSECTIVOROUS BIRDS.

Q. Which are the principal birds in that order?

A. Skrikes, fly-catchers, thrushes, warblers, and many others.

Q. What are some of their characters?

A. Their bills are straight, rounded, and have the upper mandibles a little covered at the point. Their notes are mostly musical; they live upon insects, and sometimes berries; build their nests apart from each other; and generally breed more than once in the year.

Q. Are they numerous?

A. They are rather so; and they are useful birds to man in destroying insects and snails, of which last the thrushes destroy vast numbers.

ORDER IV.—GRANIVOROUS BIRDS.

Q. What birds belong to that order?

A. Larks, titmice, buntings, finches, canary birds, orioles, and many others.

Q. What are some of their characters?

A. They have strong conical bills, live in pairs, migrate in flocks; feed mostly on seeds, but feed their young with insects; they approach the habitations of man, and live in confinement. Many of them are birds of song; and the summer plumage of the male is usually much more splendid than the winter.

Q. Are they useful to man?

A. In some cases they are rather hurtful, as they feed on seeds, and sometimes on buds, which they eat very dexterously from the trees.

ORDER V.—YOKE-TOED BIRDS.

Q. Are there many birds in that order?

A. There are a good many in all countries, and in the warm latitudes they are exceedingly numerous.

Q. Which are some of them?

A. Cuckoos, toucans, parrots in all their variety, woodpeckers, conynichs, and many others.

Q. What are their distinguishing characters?

A. Their food is very different, and so are their beaks. In some, as the woodpecker, the beak is long and straight; in others, as the parrots, it is a pair of nut-crackers.

Q. Have they no general character?

A. That of the toes acting two against two; but some of them can remove the outer toe, and use it either before or behind.

Q. Where do they inhabit?

in trees continually, as the feet are not suited for walking on the ground.

ORDER VI.—ANISODACTYLOUS BIRDS.

Q. Which are some of the birds with climbing feet?

A. Nuthatches, creepers, humming-birds, the trooper, and some others.

Q. What are their characters?

A. Most of them run upon the trunks and boughs of trees, but some of them feed upon insects.

Q. Are not the humming-birds remarkable for something?

A. They are remarkable for their great number and variety, for the beauty of their colours, and for the smallness of their size.

Q. What is the size of the smallest ones?

A. About an inch and-a-half in length, and it weighs no more than twenty grains.

Q. What are the eggs like?

A. Not much bigger than grains of mustard seed.

Q. Do the humming-birds feed upon insects?

A. They are generally understood to feed upon the honey in the nectaries of flowers.

ORDER VII.—KINGSFISHER BIRDS.

Q. Is that an extensive order?

A. No, it contains very few birds.

Q. What are their leading characters?

A. They can neither walk nor climb; but they are very rapid on the wing, and almost instantaneous in the changes of their motions.

Q. On what do they feed?

A. The bee-eater feeds on the larger insects;

common kingsfisher on little fishes, which it seizes with much dexterity; and the large brown kingsfisher, which is a native of the southern hemisphere, also feeds on fish.

Q. Where do the kingfishers nestle?

A. In holes by the sides of rivers.

ORDER VIII.—CHELIDONIAN BIRDS.

Q. What birds belong to that order?

A. The different species of swallows and goat-suckers.

Q. Do the latter suck goats?

A. Of course not; they live entirely upon insects; and have got that absurd name from following animals, upon the skins of which insects settle.

Q. Do any of the order remain in England all the year round?

A. No, they are only summer visitants.

Q. Are there many species of swallows?

A. There are—the house-swallow, which is blackish blue above, and whitish below, and builds in chimneys; the window-swallow, which builds in the corners of windows or on walls; and the sand-martin, which is lighter coloured than the others, and some others.

Q. Is there not another kindred genus?

A. Yes, the swifts, which are, excepting perhaps some of the humming-birds, among the swiftest birds that fly.

Q. How do the birds of this order feed?

A. They catch insects when on the wing; and the keenness of their vision to discover is as remarkable as the rapidity of their motion to seize.

ORDER IX.—COLUMBINE BIRDS.

Q. What are the general character of the pigeons?

A. They are very elegantly shaped birds; the colours, though by no means gaudy, are fine; they are warm in their temperaments, and they consume more food than any other birds of an equal size.

Q. Are there many of them?

A. There are a good many species—the varieties of the domesticated ones are very many, and as they breed very fast they are found in great numbers.

Q. To what order have the pigeons the greatest resemblance?

A. To the *gallinæ*, or poultry; and some of the pigeons in the south-east of Asia seem to be a sort of link between the two orders.

ORDER X.—GALLINACEOUS BIRDS.

Q. From what are the birds of that order named?

A. From the resemblance that they all bear to the domestic cock.

Q. What are the birds belonging to the order?

A. Peacocks, turkeys, common fowls, pheasants, grouse, partridges, and some others.

Q. What characters have they in common?

A. They walk heavily, and fly more so, and with much apparent effort; and they live in families. Most of the males have the *tarsi* armed with spurs, which are their weapons of war.

ORDER XI.—CURSORES, OR RUNNERS.

Q. Which are the birds that belong to that order?

A. The bustard, the ostrich, the rhea, and the cassowary, are the principal ones.

Q. Which are their distinguishing characteristics?

A. They have the legs very long, and naked for so far above the knees, no toes behind, and three, and in some of the species only two, forward. Some of them can fly none, and all of them but little.

Q. Where do they inhabit?

A. They generally inhabit remote and desart places, and are very shy.

Q. Are they all natives of the same countries?

A. No. Two species of bustards are found in the warm parts of Europe, and used not to be uncommon as seasonal birds in England before the country was so populous.

Q. Where are the ostriches met with?

A. In Africa and the south-west of Asia.

Q. Where the rheas?

A. There is one in the plains of South America, and another in Australia, where it is called the emu.

ORDER XII.—GRALLÆ, OR WADERS.

Q. Are they numerous?

A. They are a very numerous order of birds, and they are very much diversified in their characters.

Q. What birds does the order contain?

A. Plovers, sandpipers, lapwings, cranes, storks, herons, the flamingo, the spoonbill, ibises, snipes, and a great variety of other birds.

Q. Where do they frequent?

A. Some of them frequent the shores of the sea, and others the margins of ponds and lakes, and moist places.

ORDER XIII.—FIN-FOOTED BIRDS.

Q. What are the characters of these?

A. The bill is straight, and of a medium size. They have three toes before and one behind, with marginal webs. They are excellent swimmers and divers, and they have considerable powers of flight.

Q. On what do they subsist?

A. On insects, worms, fish, and sometimes vegetables.

Q. What sort of plumage have they?

A. It is very firm and glossy, and contains a great deal of down.

Q. Can they walk well on land?

A. Generally speaking they cannot.

Q. What are the names of the principal genera?

A. The principal ones are coots and grebes.

ORDER XIV.—WEB-FOOTED BIRDS.

Q. Are these a numerous order?

A. They are very numerous.

Q. Whether do they live most on the land, or in the water?

A. They live most in the water, and they are better adapted to that element than any other order of birds.

Q. How are they adapted?

A. Their plumage is so compact and thick that the temperature of the water can have little or no effect on them, and they are more abundantly supplied with oil for the dressing of their feathers, than any other birds. Their webbed feet also answer as broad paddles, and force them through the water with g rapidity.

Q. Do they swim in any peculiar manner?

A. Yes, they walk through the water, as it were, moving the one foot forward, while the action of the other is impelling the body; and thus their progress is uniform.

Q. Do they perform any other operation in the water than swimming on the surface?

A. Many of them can dive, and spend the greater part of their time actually under the water.

Q. On what do they feed?

A. The greater number feed upon fish; but some prefer vegetables, and the flesh of those that do so is much esteemed as food, while that of the others is not relished.

Q. Which are some of them?

A. The whole races of ducks, geese, and swans belong to the order.

Q. Which are some of the others?

A. The cutwater, an American bird, which is constantly on the wing, terns, gulls, petrels, albatrosses, pelicans, auks, penguins, and an almost countless number of others.

Q. Do the individuals appear in great numbers?

A. In rocky places, which are remote and undisturbed, they are often in numbers that are altogether incredible, many millions in one flock.

PART III.—SOME ORDERS of BRITISH BIRDS.

Q. ARE the British birds numerous?

A. There is a considerable number of them; and as the surface of Britain is much diversified, the shores, indented by arms of the sea and rivers, and in some parts of the country the lakes numerous, the birds are much varied in their kinds and habits.

Q. Are there many British birds of prey?

A. The number is considerable; but as they are hunted and destroyed with possibly more zeal than wisdom, the individuals in the more powerful kinds are but few.

Q. Are there any of the order wanting?

A. There are of course many species, and there is one tribe; there being no British vulture.

Q. What is the usual division of the British birds of prey?

A. There are two genera—hawks (FALCO), and owls (STRIX).

Q. What are the tribes of the hawks?

A. There are six of them—

1. Eagles,
2. Kites,
3. Buzzards,
4. Harriers,
5. Hawks,
6. Falcons.

Eagles.

Q. What are the distinguishing characters of the eagles?

A. Superior size and strength, more lonely and retired habits, and a loftier flight.

Q. How many British eagles are there?

A. There are three species; but as their plumage and appearance vary in the young and the full-grown, they have sometimes been considered as more numerous.

Q. Which are the three?

A. The golden eagle (*chrysaëtos*), the white-tailed eagle (*albicilla*), and the osprey (*haliaëtus*).

Q. Where does the golden eagle inhabit?

A. The wild mountainous parts of Scotland and Ireland.

Q. What is its size?

A. The female, which is the largest bird, is often more than three feet long, and eight feet in the stretch of the wings.

Q. What is its prey?

A. Mountain birds and small quadrupeds, the young and weak of the wild deer, and sometimes lambs.

Q. Does it fish?

A. It is a land bird, and not known to fish or to eat fish; but in extremities of hunger it will eat carrion.

Q. Where do those eagles form their nests?

A. In lofty cliffs; they have seldom more than two young in the year, which they feed with great assiduity till fledged, and then drive away. The old ones seldom go very far from home.

Q. What is the colour of the golden eagle?

A. A mixture of black, brown, and orange; the young have the insides of the thighs, and the under tail coverts white.

Q. What is the locality of the white-tailed eagle?

A. It is more diffused than the former; and as it is a fishing bird, it is found on many of the rocky shores: but still it is most abundant in the northern parts of the country.

Q. Is it a powerful bird?

A. It is, though not so strong or well made as the golden eagle.

Q. Does it feed wholly on fish?

A. No. Indiscriminately on fish and land animals.

Q. What is its colour?

A. It is not so dark as the golden eagle, and more of an ash-colour.

Q. What are the haunts of the osprey?

A. The shores of the sea and the margins of lakes, almost exclusively. It lives by fishing; beats over the surface of the water, and shoots down with the rapidity of an arrow when it sees a fish near the surface. Its plumage on the under part of the body resembles that of the water-fowl.

Q. What are its colours?

A. Brownish and mottled on the upper part, and white below.

Kites.

Q. Are there many British kites?

A. There is only one, which is a beautiful bird, with a forked tail, and remarkable for the gracefulness of its flight.

Q. Of what places is it an inhabitant?

A. Of the cultivated countries, rather than the wilds like the eagles.

Q. What is its prey?

A. Birds and small quadrupeds. It is voracious, but supposed to be rather cowardly in proportion to its size.

Q. Where does it make its nest?

A. In trees; and it prefers those parts of the country that contain woods and coppices.

Buzzards.

Q. Are there many species of these?

A. There are three. The common buzzard (*buteo*), the rough-legged (*lagopus*), and the honey buzzard (*apivorus*).

Q. Where does the common buzzard inhabit?

A. Woody districts, where it is often found perched on a withered tree. It is a heavy bird.

Q. What is its prey?

A. Birds, small quadrupeds, and sometimes frogs and insects.

Q. Where does it catch its prey?

A. Always upon the ground. In some countries it is eaten.

Q. What is its colour?

A. The colour varies considerably, but the shape and habits of the bird cannot be mistaken.

Q. What is the character of the rough-legged buzzard?

A. The tarsi are feathered. It is a native of the very northern parts of Europe, and visits Britain only occasionally.

Q. What is the honey buzzard?

A. It is smaller than the others, and feeds partly on insects. It is very rare in Britain.

Harriers.

Q. What are the characters of these?

A. They have often a ruff of feathers about their necks; they beat over the surface of the ground on a low flight, and pounce on their prey.

Q. Are there many of them?

A. There are three. The marsh harrier, the hen harrier, and the ash-coloured harrier.

Q. Where does the marsh harrier inhabit?

A. Marshes, where it preys on ducks or other water-fowl; or low sandy commons, where it preys on rabbits.

Q. Where does the hen harrier frequent?

A. Fields, where it is very destructive to game. It also preys upon mice and reptiles.

Q. The ash-coloured harrier?

A. It is a bird of the uplands, and flies more vigorously than the other harriers, but it is not common in this country.

Q. Where does it form its nest?

A. On the ground, among furze, or other bushes.

Hawks.

Q. Are there many British species of hawks?

A. Of hawks, properly so called, there are only two.

Q. What are the distinguishing characters of a hawk?

A. They are three. The first quill of the wing is very short; flight rapid; they strike their prey upon the wing, are bold, and will attack birds much larger than themselves.

Q. Which are the British species?

A. The gos-hawk and the sparrow-hawk.

Q. Where does the gos-hawk inhabit?

A. In the wild districts of the north. It preys upon hares, rabbits, and the larger birds.

Q. Where does the sparrow-hawk inhabit.

A. It is pretty generally diffused, especially in the cultivated parts of the country. It is very destructive to game and pigeons.

Q. Is there not a remarkable difference in the sexes?

A. Yes, the female is very much larger than the male. It will prey upon its own species.

Falcons.

Q. What are the characters of the falcons?

A. A tooth on the upper mandible of the beak, and a corresponding notch on the lower one; the wings long, and the second feather the longest.

Q. Are there many British falcons?

A. There are at least five species. The jer-falcon, the peregrine, the hobby, the merlin, and the kestril.

Q. Where does the jer-falcon inhabit?

A. It is found in Scotland, though its proper place of habitation is farther to the north.

Q. Is it a powerful bird?

A. Yes, very powerful and very daring. Its prey is game and large birds, which it strikes with amazing force. It is rarely if ever seen in England.

Q. Where is the peregrine falcon found?

A. Chiefly in the north too, though it is occasionally met with in England.

Q. Is it a bold bird?

A. Very much so. It sometimes accompanies sportsman during the grouse-shooting on the moors, and shares with them the coveys of birds raised by the dogs. It can fly at the rate of more than 150 miles an hour.

Q. Where is the hobby found?

A. It is a summer visitant, and found only in some of the southern parts of England.

Q. What form its prey?

A. Larks and other small birds, in pursuit of which it flies with great rapidity.

Q. What are the characters of the merlin?

A. Smallness of size, boldness, and activity. Its prey is small birds, and it follows them in their seasonal migrations, though itself breeds in the country.

Q. Where does the kestril inhabit?

A. Most parts of the country; but it retires to rocky places in the wintry season.

Q. What are its chief food?

A. Mice and large beetles, especially cock-chaffers.

Q. How does it catch the latter?

A. It darts through the swarms of them that are flying about in the summer twilight, catches one in each foot, and eats them on the wing.

Owls.

Q. What are the characters of the owls?

A. They have the bill hooked, the eyes large, the face broad, the plumage so soft and downy that they make no noise when they fly, and they fly chiefly during the night.

Q. Is there not something peculiar in the formation of their ears?

A. They are much more elaborate in their structure than in other birds.

Q. Are there not two divisions of owls?

A. There are smooth-headed owls and horned owls?

Q. What is meant by horned owls?

A. Owls that have a tuft of feathers standing up on each side of the head.

Q. How many British species are there?

A. Four of each kind are occasionally met with in the country.

Q. Which is the most remarkable?

A. The great-horned owl, which is as large as an eagle; but it is only an occasional visitant.

Q. Is it as powerful as the eagles?

A. Very far from it, though it can kill grouse and rabbits. The skeleton is very slender as compared with that of the eagles.

Q. Which is the next species?

A. The long-horned or long-eared owl; its colours are handsome.

Q. Where does it inhabit?

A. Woods, and it feeds chiefly on mice and moles. When wounded, it fights lying on its back.

Q. Which is the third?

A. The short-eared owl, which winters in the southern parts of the island, and summers in the northern. It preys on mice and small birds.

Q. Which is the last of the British eared owls?

A. The scops-eared owl. It is a small and handsome species, rarely met with in England, but common in warmer countries, where it is a seasonal migrant. It feeds on mice, insects, and worms. This little owl is easily tamed.

Q. Which are the smooth-headed owls?

A. The snowy-owl, the white or barn-owl, the tawny owl, and the little owl.

Q. Where does the snowy-owl inhabit?

A. It is a native of the snowy regions of the world; but it is sometimes met with in Scotland, and more rarely in the north of England during severe snow-storms from the north.

Q. What are its characters?

A. It is a large, beautiful, and powerful bird, prey-ing upon alpine hares, rabbits, and other animals, which it catches in the day-time. In the old birds, though their bill is black, the plumage is snow-white, and the animal distinguished with difficulty from the snow on which it sits.

Q. Where does the barn-owl, or white owl, inhabit?

A. It is common in most parts of Britain, and found about old buildings and hollow trees. As it flies, it utters loud screams; on which account it is called the screech-owl. On its perch, it makes a hissing and moaning noise. Mice are its principal food; and thus it is valuable about farm-yards. When young, it is easily tamed, and becomes very domestic.

Q. Where does the tawny owl inhabit?

A. Like the former, it is very generally diffused; but it does not come so familiarly near the habitations of man. Its favourite abode is in woods and thickets, where it hoots, in a very noisy manner, during the night.

Q. Is it as harmless as the white owl?

A. By no means. It destroys rabbits, young hares, and pigeons.

Q. Where does the little owl inhabit?

A. It is a native of warmer climates, and rarely seen in this country. Though small, it has some of the characters of the hawks, and pursues birds during the day.

Q. Are there many species of British

OMNIVOROUS BIRDS?

A. There are, at least, not fewer than fourteen.

Q. Which is the most common genus?

A. That which includes the several species of crows (*corvus*).

Q. What are their characters?

A. The bill is middle-sized, strong, horny, coulter-shaped at the edges, and adapted for thrusting or digging. They live in pairs, and some of the species in societies. They are very indiscriminate in their eating.

Q. Which is the most powerful of the genus?

A. The raven (*corax*); and its power of endurance is equal to its strength, for it can stand every climate, however cold, or however warm.

Q. Then are ravens found in all parts of the world?

A. They are: from the snows of Greenland to the most sultry climes.

Q. What are the favourite haunts of the raven?

A. Woods and wild rocky places; but as its sense of smell is very acute, offal and carrion can bring it to any place.

Q. Is its food confined to substances of that description?

A. No; it is very destructive to game, to lambs, and to sheep that are diseased.

Q. What is its mode of attack upon large animals?

A. It first punches out their eyes with its formidable beak; and then they become an easy prey.

Q. Can the raven be tamed?

A. It can, and when that is done while it is young, it may be taught a number of tricks, and even to pronounce words.

Q. Is that common to any other of the crow tribe?

A. Many of the order can be made to articulate; and perhaps those birds that have the hardest natural voices are the most easily taught to speak.

Q. Are the ravens gregarious?

A. No, they live only in pairs.

Q. Are they long lived?

A. Very much so; but the precise period of their natural lives is not known. Pairs have been known to frequent the same cliffs for more than a century.

Q. What is the colour of the raven?

A. Wholly black, beak and all; but the upper part is glossed with blue.

Q. What other species most resemble the raven?

A. The carrion crow (*corone*); but it is not nearly so large, and the gloss on its back has a greenish tinge.

Q. Where do they inhabit?

A. Wooded districts are their favourite places; but they are found generally all over the country.

Q. On what do the carrion crows feed?

A. On carrion, on the young of birds and small quadrupeds, eggs, roots, and sometimes on pigeons and other birds which they can master.

Q. Is there any other species resembling the raven?

A. Yes, the hooded crow—of which the head, wings, and tail are black, and the rest of the body grey—has some of the characters and habits of the raven.

Q. Where does it inhabit?

A. It is found chiefly in the northern parts of the island, where it remains the greater part of the year, resorting to the shores in winter, where it feeds upon shell-fish. In England it is a seasonal bird, appearing in October, and departing in the spring.

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Q. Are there many Yoke-footed Birds?

A. There are two visitants—the cuckoo and the wryneck; and several woodpeckers, which are constant, though peculiar in their localities.

Q. What is the character of those birds as depending on the feet?

A. They can run up the trunks and branches of trees, but not down.

Q. On what do they feed?

A. Wholly upon insects and their larvæ. The cuckoo upon the living larva of butterflies and moths.*

Q. Is there not something peculiar in the habits of the cuckoo?

A. There are many things peculiar in its habits. It is a retired and solitary bird, seldom more than one being seen at a time. It comes late to Britain, and is understood to quit the country early. Its young are said to be hatched and reared by other birds; and, altogether, it is an anomaly among birds.

Q. Why does the other yoke-toed visitant get the name of wryneck?

A. As it moves its head in search of food, in the crevices of the bark of trees, a line that reaches from the nape down the back is constantly bending.

Q. Is it a handsome bird?

A. The markings of the colours are remarkably fine.

Q. When does it come?

A. A few days before the cuckoo; but it is not so widely diffused over the island as that bird, being confined to England.

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* See Catechism of Insects.

Q. Where does it build its nest?

A. In holes of old trees.

Q. What forms its principal food?

A. Ants and their eggs, of which it consumes great numbers.

Q. You mentioned the woodpeckers, are there many of them?

A. There are three British species, one green, and two spotted.

Q. Which is the most common?

A. The green, which is found in most of the wooded parts of England and Scotland.

Q. Then it inhabits trees?

A. Yes, it does; and is seldom found on the ground unless when attacking the ants. It builds in natural holes of the trees, or in holes that it makes itself; and it finds the greater part of its food in the bark, or in the wood under it.

Q. How does it get at its food?

A. Sometimes the tapping which it makes on the tree with its bill forces out the insects, sometimes it digs down to them, and sometimes it brings them out of their holes with its tongue, which it can extend rapidly, and which is beset with spines turned backward, and covered with a substance to which the insects adhere.

Q. And it sometimes makes a hole in a tree for its nest?

A. Yes; and does it very rapidly. The bill strikes so quick that the motion is not seen; and yet the sound it makes can sometimes be heard half a mile off.

Q. How does it adhere to the tree whilst performing this operation?

A. Its feet are short, and the claws very strong, so that it holds with those, at the same time that it places its stiff tail against the tree lower down as a prop.

Q. What are its colours?

A. The prevailing ones are green and yellow, and the crown of the head and the moustaches red. It is not unlike some of the mossy trunks of old trees.

Q. What are the spotted woodpeckers?

A. They are the greater and the less; but none of them so common in Britain as the green one.

Q. Where is the great spotted woodpecker found?

A. In wild and lonely woods in the north parts of the country. It is chiefly found on pines and birches, and its colours something resemble their bark.

Q. Do they excavate their nests in the same manner as the green woodpeckers?

A. They probably do it more habitually, as the trees among which they are found are not so apt to be hollow.

Q. Where has the small spotted species been found?

A. Only in the inland counties in the west of England.

Q. Then taking them altogether, the yoke-toed birds are a curious order?

A. They are all singular in their habits, and well worthy of study.

Q. Is there any thing peculiar in the habits of the unequal-toed birds—the

ANISODACTYLI?

A. Their characteristic peculiarity is that they can run rapidly along the bark of trees, in all directions, upwards, downwards, or horizontally.

Q. What are their leading characters?

A. The bill is sometimes straight, and sometimes curved, but it always has a fine point; the feet have three toes before and one behind, the hind one generally strong; the outer toe is joined at its base to the middle one; and the claws are long, barbed, and sharp.

Q. On what surfaces are they adapted for moving?

A. On the trunks and branches of trees, and also on walls and perpendicular rocks.

Q. Which are the genera?

A. The nuthatch (*sitta*), the creeper (*certhia*), and the horpoe (*upupa*); they are all small birds.

Q. Are there many species of nuthatch?

A. There is only one. It is found in many parts of England, but not in Scotland; they are found also on many parts of the continent, and they are never migratory.

Q. Where do they reside?

A. In trees, in the holes of which they nestle; and they pick insects and larva from the crevices of the bark.

Q. Does the tail assist them in climbing as it does the woodpeckers?

A. It does.

Q. What are their colours?

A. White on the sides of the face and throat, buff on the belly, and reddish brown and blueish above. They have a black streak from the opening of the bill, down each side of the neck.

Q. What are the characters of the creepers?

A. The bill is long, slender, triangular and sharp-pointed, the tail wedge-shaped, formed of twelve very stiff feathers. They feed wholly upon insects and larvæ.

Q. Are there many British species?

A. Only one, and, except the golden-crested wren, it is the smallest of British birds.

Q. Where is it found?

A. Generally in woods throughout England and Scotland. It climbs admirably, running up the trees in a sort of spiral.

Q. What are its colours?

A. White below; and brown and black above. It nestles in holes of trees.

Q. What are some of the characters of the hoopoe?

A. The claws are shorter, and not so well adapted for climbing as those of the creeper; and the tail is square at the end. It is only an occasional visitant. It has a movable crest, and is beautifully marked with black, brown, and white.

Q. Are there many British birds among the kingfishers,

ALCYONES?

A. There is only one resident—the common kingfisher. It is a curious and beautiful little bird.

Q. Is it abundant?

A. No; it is rather a scarce bird, although met with in many parts of the country.

Q. What is the appearance of the kingfisher?

A. It is about seven inches long, eleven in the spread of the wings, and weighs an ounce and a half. Plumage above, blueish green, marked with beautiful azure on the head, shoulders, back and rump; the chin white, and the rest of the under part orange-brown; the tail (which is very short) and wings greenish blue.

Q. Where does it inhabit?

A. The banks of clear streams that flow slowly, especially if they be grown with ridges and reeds.

Q. On what does it feed?

A. On small fishes and water insects, which it may be seen watching perched on a reed, and which it seizes with great dexterity.

Q. Where does it breed?

A. In holes in the banks. Though a very beautiful bird, its nest is neither very neat nor very clean.

Q. Can it be tamed?

A. It would make a beautiful aviary bird, but it cannot be reared in confinement.

Q. What do you mean by an "aviary" bird?

A. One which forms part of an artificial collection of living birds, such a collection as the place in which it is held being called an aviary.

Q. Which is another British order of a curious description?

A. The *insectivorous* birds, the swallows and goat-suckers.

Q. Are not some of those that you have mentioned already insectivorous?

A. Some of them are; but it is doubtful whether any bird which remains in Britain during the winter lives wholly upon insects, as there are times when the earth and the waters are so covered with ice and snow, that no birds but those that have access to the sea can get insects.

Q. Then the insect-eating birds, properly so called, are all summer visitants?

A. They are. The swallows, the martins, and the swifts, feed upon flies, which they capture in the air upon the wing; their powers of flight and of vision are both very wonderful. They are familiar to every body.

Q. What other British bird is there of that order?

A. The goat-sucker, which is a sort of night or twilight bird. It is found near woods and banks, and feeds upon moths, in coursing for which it makes a jarring noise, something like the sound of a spinning-wheel.

COLUMBÆ.

Q. Are there many of the Columbæ, or pigeon tribe, natives of Britain?

A. There are four; but one of them is a summer visitant of particular districts only: and another is found only in some places.

Q. What are their names?

A. The ring-dove or "cushat," the stock-dove, the rock-dove, and the turtle.

Q. Which of these is the most common?

A. In a wild state, the cushat is, being found in woods and coppices in most parts of the country.

Q. What are its colours?

A. Bluish-grey and white, with reddish-brown and green on the breast and belly.

Q. What is its size?

A. It is larger than the common pigeon.

Q. Where does the cushat nestle?

In trees; and as it builds earlier than almost any other British bird, it prefers the pine tribe.

Q. How many young does it have?

A. Only two at a batch; but there are more hatches than one in the year.

Q. Has it any song?

A. Its cooing is very plaintive, and heard at a considerable distance.

Q. On what does the ring-dove feed?

A. On grain of all kinds, especially pease, and also on acorns and beech-mast.

Q. Does it bruise those substances with its bill?

A. No; its bill is not well-adapted for bruising; its food is swallowed entire.

Q. Is the ring-dove eatable?

A. In the early part of the winter, when they resort to the stubble-lands in flocks, and feed on the grain that is left there, they are very fine, equal in flavour to grouse; but when the severe weather forces them to eat inferior food, they become rank and unpalatable.

Q. Can they be domesticated?

A. They can be tamed; but they do not breed in confinement.

Q. Where is the stock-dove found?

A. In some of the midland counties of England. It breeds in trees and coppices, and in its habits very much resembles the ring-dove?

Q. How does it differ from the ring-dove?

A. It is smaller, and darker in the colour, especially of the wings and tail.

Q. On what does it feed?

A. On grain.

Q. Are there not some mistakes about the stock-dove?

A. There are. It has been confounded with the rock-dove, though they are distinct species.

Q. What are some of the distinctions?

A. They do not breed together; the stock-dove does not breed in a domesticated state, and it is rather larger than the rock-dove.

Q. Are their habits the same?

A. They are not. The stock-dove inhabits woods; the rock-dove, in a wild state, inhabits cliffs, especially those near the sea; and it forms its nest in deep holes and caves.

Q. Is there any characteristic difference in the colours?

A. Yes; the rump of the rock-dove is white, and that of the stock-dove is blueish-grey.

Q. Does not the habit of the rock-dove, in building in holes, assimilate it to the common domestic pigeon?

A. It does, and there can be no doubt that the rock-dove is the parent-stock of all the varieties of pigeons. The other species nestle in pairs apart from each other, and always in trees, and they do not flock but in autumn and the early part of winter. The rock-doves have, even in their wild state, nearly the same habits as the tenants of a pigeon-house.

Q. But the domesticated pigeons are of different colours?

A. So are almost all domesticated birds; but most of the tame pigeons have traces of the white rump, and the two dark lines on the closed wing that characterise the rock-dove.

Q. Are there many varieties?

A. There are about twenty; and by crosses between them and the common rock-dove, new varieties may be formed without limit.

Q. What parts of Britain does the turtle inhabit?

A. The south-east of England, where it arrives about the beginning of May, and takes its departure in September.

Q. Where does it build?

A. In thick woods; but when the pear ripens, it resorts to the fields, though the flocks seldom contain more than twenty.

Q. What is its size?

A. It is much smaller than the common pigeon, and not much more than half the weight.

Q. What are its colours?

A. The fore part light brown, tinged with grey, and having a black patch on each side of the neck; the hinder part orange-grey and black, and the belly white.

Q. On what does it feed?

A. On grain and insects.

Q. Has it any note?

A. Its cooing is very plaintive, the more so that the bird itself is concealed in the depths of the forest.

Q. Is there any variety in the colours?

A. There is. The sides of the neck are sometimes black, with a white spot.

GALLINÆ.

Q. Do not the Gallinaceous birds, or fowls, have some resemblance to the pigeon tribe?

A. In some of their characters they have; but in others they differ very much.

Q. What are some of those in which they differ?

A. The pigeons build on trees, or in the holes of rocks; the *gallinæ* upon the ground. The pigeons never have more than two in one brood—the gallinæ have many; the pigeons are rapid on the wing, but run with difficulty—the gallinæ have short wings, and fly laboriously; but they run well, and the young of some of the species run the instant that they are out of the shell.

Q. Are the gallinæ valuable birds?

A. They are better food than any of the other orders.

Q. Are there many British species?

A. There are several indigenous, and some that are domesticated.

Q. What are the indigenous ones?

A. There are two tribes of them. One with the *tarsi* feathered, and one with them naked.

Q. Does that point out any difference in their habits?

A. The feathery-footed ones are all natives of the bleak upland countries, and the naked-legged of the cultivated districts.

Q. Which are the feathery-footed ones?

A. Grouse, or heath-cock, ptarmigan, and black cock.

Q. Where do the grouse inhabit?

A. The open heaths and moors; they are pretty widely diffused in Britain, and not found in any other country.

Q. Are they large birds?

A. About sixteen inches long, and twenty-six in the stretch of the wings; and the weight is about a pound and a quarter.

Q. What are their colours?

A. Brown and black, with some lines of white; and they are finely mottled and glossy.

Q. Where do they nestle?

A. On the ground; but they form hardly any nest.

Q. Are their broods numerous?

A. From eight to twelve; and they remain in company till the winter be considerably advanced.

Q. On what do they feed?

A. Chiefly upon the tender tops of heath, and upon mountain berries. In very cold seasons they come down as far as the uppermost corn-fields.

Q. Are they numerous?

A. On the northern moors they are; but they have many enemies; and man destroys a number of them every autumn.

Q. Can they be tamed?

A. They can: and they breed in that state; but they are not nearly so profitable as the common domestic poultry; and they are said to lose their flavour.

Q. Are their feet much feathered?

A. Yes; not only the tarsi, but also the toes.

Q. Where do the ptarmigan inhabit?

A. The summits of the most elevated and lonely mountains. They are met with only in Scotland, though it is said that they were formerly met with in the north of England.

Q. Do they resemble the red grouse?

A. In their form and habits they do, but not in their colour; and they are rather smaller.

Q. What are their colours?

A. Snow-white, in winter; and white, dull yellow, and black in summer.

Q. Are they as much esteemed as grouse?

A. They are a greater rarity, but they are inferior in flavour.

Q. What are the characters of the black cock?

A. It is black, with the under tail-coverts and tips of the wings white; and the black on the upper part is glossed with purple reflections.

Q. Are these birds widely diffused?

A. They are found in wild and shrubby places in most parts of the island.

Q. Are they large birds?

A. Rather more than twice the size of grouse: a full-grown male will weigh about three pounds.

Q. Which are the naked-legged species?

A. The partridge, which remains all the year round, and the quail, which is a summer visitant.

Q. Where do the partridges inhabit?

A. Cultivated countries chiefly.

Q. And the quails?

A. They come about May, and go away in October. They are not so numerous in Britain as formerly.

Q. What are the domesticated gallinæ?

A. 1. The common fowl, of which there are many varieties; but none of them live in a wild state. They are all originally from Asia.

2. The peacock, esteemed for its plumage, but of little value as food; also from Asia.

3. The pheasant (from Asia), several varieties.

4. The guinea hen, from Africa.

5. The turkey, from America, the largest of the tribe.

Some weigh as much as thirty pounds; but these are when wild in their native region.

Q. Is there any species extinct?

A. Yes, the cock of the wood was formerly met with in the wild forests of Scotland, but it has not been seen for the last seventy years.

Q. What other orders contain interesting birds?

A. All birds are interesting; but there are some peculiarly various ones among the *grallæ*, or waders.

Q. Which are some of them?

A. Those which are called *coultrirostres*, that is, that have long, straight, and pointed coulter-shaped bills.

Q. Which are these?

A. The genus *Ardea*, which contains the heron and the bittern.

Q. What are the characters of the heron?

A. It is all legs, wings, neck, and bill; measuring more than three feet and a half in length, and nearly six feet in the expanse of the wings, and yet not weighing more than three pounds.

Q. What is the length of the bill?

A. Not less than six inches, toothed, and the gape opening as far as the eyes.

Q. On what does it live?

A. On fish, which it strikes with great rapidity and unerring certainty. It is very destructive to fish-ponds.

Q. Where does it breed?

A. Numbers of them usually collect in the breeding time at the same trees, where they congregate like rooks, although not in equal numbers. Those places are called heronries.

Q. What is the colour?

A. Blueish grey, striped, and barred with black, paler below.

Q. Where does the bittern inhabit?

A. In lonely marshes; but it is by no means common.

Q. Is it as large as the heron?

A. No; it is at least a foot shorter; but it has a most formidable bill, with which it charges like a bayonet; so that hardly any animal will venture to attack it in front.

Q. What is its colour?

A. Yellowish red, with black bars and spots, and the cheeks and crown black. It is coloured very like the withered reeds and rushes, in which it makes its nest.

Q. Is it a retiring bird?

A. Yes, it is a twilight bird; and as the country gets more peopled and cultivated it leaves its haunts, and its numbers decrease.

Q. Does not the bittern make a singular noise?

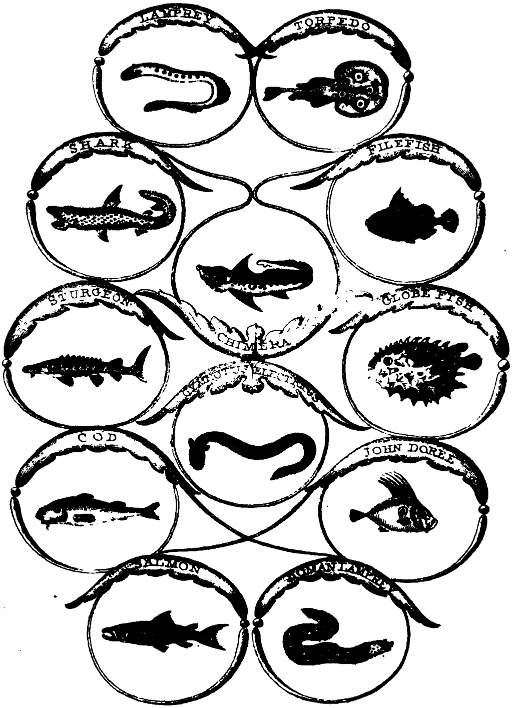
A. It does, and a very loud one, in the evenings about the beginning of summer.

Q. What position does it hold as it makes that noise?

A. It flies upward in a spiral to a great height, the revolutions getting larger and larger as it ascends.

THE END.

LONDON:
ENRY BAYLIS, JOHNSON'S-COURT, FLEET-STREET.



Engraved by C. Marr.

PINNOCK'S

CATECHISM

OF

ZOOLOGY.

PART III.

FISHES.

LONDON.
PRINTED FOR WHITTAKER, TREACHER, & Co.
AVE MARIA LANE.
1831

CATECHISM OF ZOOLOGY.

PART III.

ICHTHYOLOGY, OR FISHES.

CHAPTER I.

INTRODUCTION.

Q. WHAT is meant by Ichthyology?

A. That part of natural history which explains the appearances, habits, habitations, and uses of fishes.†

Q. Does a *fish* mean an animal that *lives* in water?

A. All fishes do live in water, but there are many living inhabitants of the water that are not fishes. A fish is an animal which has a spine or back-bone made up of joints, or vertebræ, and *breathes water*.

Q. Has a fish lungs composed of cells?

A. The breathing organs of all fishes, though some of them are contained in cells, are always composed of fringe-like fibres, which are called *gills*.

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* *Ichthyology*, from the Greek Ιχθυς a fish, and λογος an explanation, "the description or explanation of fishes."

† "Fish" and "fishes" are both used as plurals; but "fish" may be all of the same kind, "fishes" of different kinds.

Q. Are these peculiar to fishes?

A. Through life they are in all animals that have back-bones, but some reptiles have them when young.[*]

Q. Is ichthyology an extensive department of natural history?

A. It is. The water, including the sea, lakes, and rivers, occupies fully three-fourths of the surface of the globe, and the average depth is guessed at about two miles, so that the whole range of space fit for the habitations of fish is not much short of three hundred millions of miles, which is ample room for an almost incredible number of inhabitants.

Q. Why should the depth be taken into the account?

A. Because fish, by their power of swimming, can live in all parts of the water from the very bottom to the surface; and as they live upon substances that float on the water, they may be ranged in hundreds or even thousands of strata over each other?

Q. Are the species many?

A. The known species are numerous, and we know not how many more may lie in those depths of the ocean which no line can fathom.

Q. Are the individuals numerous?

A. They are remarkably so; and their powers of increase are truly astonishing.

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[*] See Catechism of Zoology, Part 4, *Reptiles*, order *Batrachia*.

Q. Can you mention an instance?

A. Nearly four millions of eggs have been counted in the roe of one cod-fish, and as fishes seem to be exempted from many of the causes of decay in land animals, the same fish may produce hundreds of families all equally numerous.

Q. Then how are the numbers kept down?

A. The larger ones prey upon the smaller, even their own offspring?

Q. Then the water is improperly termed a waste?

A. It is; for it contains in itself the whole means of support of more living creatures than are probably to be met with any where else.

Q. Why do you say their whole means of support?

A. Because fishes find their breath, as well as the principal part of their food in the water.

Q. And do not the beasts of the field and the fowls of the air find also their whole nourishment in these?

A. No. The animals that live upon land breathe air, and the birds find their food upon or from the earth.

Q. Then fishes are an important class of animals?

A. They are highly important, and in sea-coast countries and islands perhaps more important than any others.

Q. What are some of the uses of them?

A. They are numerous, but the following are a few.

1. They form an excellent article of food, which costs nothing but the catching.

2. Some parts of them form isinglass, which is

when seasoned, a very light and pleasant food, and also very valuable for fining liquors and as a glue.

3. Other parts of them yield oils, which are very useful in the arts, and even are better for many purposes than the oils obtained from land animals.

4. The refuse of them is an excellent manure for land.

5. The skins of some of them form a beautiful covering for boxes and other articles, and parts of those of others answer as files for polishing.

6. Many of the parts that are thrown away in dressing fish for food *might* become very valuable as jellies or glues.

Q. Is there any marked distinction between useful fish and other useful animals?

A. There is this remarkable distinction, that, unless man wishes to have fish in places where they would not naturally be found, fish require no food and no care at the hand of man. No meadow is required for the salmon and the turbot, and numerous as are the shoals of cod, herrings, mackerel, and pilchards, they find their way to our shores at those times when they are in the best condition for food without any guidance of a herdsman.

Q. Are they more valuable in those respects than the wild land animals?

A. They are; for those species that are accounted game in England destroy much more of the produce of the fields than their own worth; but except in so far as they prey upon each other, and that is amply compensated by their powers of increase, fish diminish nothing that can be useful to man.

Q. Do any countries derive more benefit from fish than others?

A. Islands, and places near the sea, afford of course the most ready and abundant supplies; and as the sea contains no desart places like the land, wherever it is accessible food may always be found in it.

Q. Are any uses made of the bones of fishes?

A. Their bones are in general too soft for being used as substitutes for common bone or ivory, but they are tough, and savage nations sometimes make fishing-hooks of them. In some parts of the northern countries cows are sometimes fed upon fish-bones, and in places still farther to the north they are dried and ground for meal, and made into a sort of bread.

Q. Is the study of ichthyology attended with any peculiar difficulties?

A. It is. From the nature of the element in which fishes live their habits cannot be known; and as the rarer kinds are seldom seen, and then chiefly by ignorant fishermen, and as they change soon after they are out of the water, they are often very inaccurately described.

Q. What are the consequences?

A. That there is more incorrectness in the common books that profess to treat of the natural history of fishes, than in those upon any other class of natural bodies.

Q. What is the most general division of ichthyology?

A. One division may be the structure, functions, and habits of fishes, and another their arrangement into a system, and both of these may admit of farther subdivision.

PART I.—STRUCTURE OF FISHES.*

Q. Is there any general observation to be made respecting the organization of fishes?

A. Yes. As they all live in water the whole of their organization is, of course, adapted to that element, and not, generally speaking, to any other.

SECTION I.—BONES OF FISHES.

Q. Are the bones of fishes all of the same texture?

A. No. Though none of them be so hard as the bones of land animals, or have the cellular structure that is exhibited in the larger bones of the mammalia, yet some contain so little earthy salt as to resemble *cartilage* or gristle, while others are of a texture intermediate between gristle and bone.

Q. Are any conclusions drawn from this texture of the bones?

A. Yes, two; first the bones continue to increase in size while the fish lives, and thus a fish appears to have no old age, or state of natural decay, which without disease would terminate in death; and secondly, the fishes that have cartilage, and those that have harder bones, all agree in each class, and differ in the two classes in so many important particulars, that *cartilaginous* fishes, and *osseous* or *bony* fishes, form two very natural, and therefore useful sub-classes in the arrangement of fishes.

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* As the space to which these pages are limited sets all system at defiance, the functions are hinted at along with the structures by which they are performed.

Q. Of what parts is the skeleton or bony structure of fishes made up?

A. Of a cranium, or skull-bone; a spine, or backbone; ribs (in most of the species), and various smaller bones.

Q. What is the general character of the cranium?

A. It varies a great deal both in shape and size, but it is in general large both for the size of the fish and for that of the brain which it contains.

Q. What is the general character of the spine?

A. It is formed of a great number of *vertebræ*, or pieces, the ends of which are funnel-shaped, and they have no perforation for spinal marrow like the vertebræ of land animals.

Q. Have they no spinal cord then?

A. Yes they have; but that is contained in divisions of the spinous processes, with which the spine is pectinated, or formed like a comb.

Q. How are the junctions of the vertebræ formed?

A. The edges of the opening funnels are fastened by gelatinous or cartilaginous matter, and in the cartilaginous fishes, of which all the bones are flexible, the joints are hardly to be distinguished.

Q. Are the hollow ends of the bones empty?

A. No; they are filled with cartilaginous matter, which is formed in concentric rings, and some have pretended that the number of these rings denotes the years that the fish is old, but the opinion is unfounded, or at any rate unproved and improbable?*

Q. Are the spines on the back-bone of a fish not the ribs?

A. No; they are only branches, or projections of the back-bone, which for that reason is called the *spine*.

Q. What is the arrangement of these processes?

A. In fishes that have necks the spines are short; in these they are generally in three rows, one above and one at each side; and in the tail there are two rows, one above and the other below.

Q. How much of a fish is reckoned tail?

A. From the opening of the belly to the tail-fin.

Q. How are the ribs situated?

A. Cartilaginous fishes have, in general, no ribs. But those fishes that have ribs, have them articulated to the lateral processes of the spine.

Q. How are the bones of fishes articulated together?

A. Generally by cartilage, so that the joints resemble hinges of Indian rubber or leather, in their motions, though not in their substance.

Q. Does any advantage result from that?

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* This foolish notion is founded on the analogy of trees and the horns of sheep and cattle, in which a ring of hard matter is formed every year, from the outside in the tree, and the inside of the horn; but these are hard matters, and the old ones lose their irritability, which is not the case with the cartilages in the spines of fishes.

A. Yes; such articulations bend freely in all directions, which the joints of the mammalia do not, as a knee cannot be bent outwards to the back, or an ancle to the front.

Q. Are any of the characters of the bones of use in distinguishing fishes?

A. Yes; especially the number of vertebræ, and the number of ribs.

SECTION II.—COVERINGS OF FISHES.

Q. What are the coverings of fishes?

A. They have no hair, wool, or feathers, but skin, scales, and spines or tubercles.

Q. What are the characters of the skin?

A. It consists of a *cutis*, or true skin, which adheres much more closely to the parts beneath than in the other back-boned animals; of a mucous layer, in which the colours reside, and a scarf-skin or cuticle. The cuticle is periodically cast.

Q. Of what is the skin chiefly composed?

A Of gelatine; and therefore it makes nutritious food, and also glue or jelly.

Q. How does the skin vary?

A. In those fishes that have the scales small it is usually very thick, and in those that have the scales large it is thin.

Q. What is the arrangement of the scales?

A. They are generally imbricated, or placed over each other like tiles, with the hinder edges free of the skin.

Q. Does that answer any purpose?

A. It prevents the motion of the fish backwards, and thus increases its progress forwards. When the body is bent to one side by the motion of the tail, the back edges of the scales on the other, or convex side, lay hold of the water like so many little oars.

Q. What is the form of the free edge of the scales?

A. It is generally rounded; sometimes it is smooth, and sometimes it has a little fringe.

Q. Are the scales of fishes like those of reptiles?

A. No; they are quite different. The scales of reptiles are horn, like the claws or nails of animals, and those of fishes more nearly resemble bone, or rather, those shells that are called pearl, or mother of pearl.

Q. But scales may be bent?

A. They may. They consist of thin layers of a flexible membrane, often very curiously arranged, and containing phosphate of lime between them.

Q. And is the brilliant colour of the scales of fishes owing to this composition?

A. The play of colours is; and, for the same reason, hollow balls of glass, coated inside with a paste of ground shells, resemble pearls, while balls made of the same in a paste with isinglass, can hardly be distinguished from real pearls.

Q. Are the scales placed on the cuticle?

A. They are rather inclosed in it, and they are reproduced again when rubbed off.

Q. What are the other hard coverings of fishes?

A. In some they are large, detached, bony plates, as if the fish were stuck over with limpet-shells; in others they are round, hard tubercles; and in others again they resemble teeth.

Q. Are there any other hard coverings?

A. Some fishes have horny spines on different parts of their bodies, and others have a hard covering so general and connected, as almost to deserve the name of a shell.

Q. Is there any thing further worthy of notice in the coverings of fishes?

A. Their skins often secrete a sort of mucus* or slime, by which they are kept soft, and probably defended from the action of the water.

SECTION III.—SENSATION OF FISHES.

Q. What are the general organs of sensation in fishes?

A. A brain, spinal cord, and nerves, as in the other vertebrated animals.

Q. What is the character of the brain?

A. It is softer, smaller, rather more subdivided, and fills the cavity of the skull less completely than that of warm-blooded animals.

Q. Has it any more protection than the brain of land animals?

A. It floats in a salt liquid, by which it is no doubt better defended against the resistance of the water, when the fish moves rapidly, and against the varying pressure when it is at different depths.

Q. Have we any instance of a similar provision in land animals?

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* The word *mucus* is not used here in a strictly chemical sense.

A. We have, against general concussion, in the joints of the limbs of many animals, and in the pad upon the camel's foot.

Q. What are the characters of the spinal cord and nerves?

A. Their size depends more on that of the body of the fish than the brain: they are softer than the nerves of warm-blooded animals, and they are not so minutely ramified.

Q. Have fishes the same five senses as land animals?

A. It is probable that they have, to some extent or other, though both the organs and the functions are much modified by the element in which they live, and the subject is altogether very obscure and difficult.

SMELL.

Q. Have fishes organs of smell?

A. They have nostrils, and *olfactory* or smelling nerves; but as the nostrils are in general small, and there is no provision by which water can be drawn in and out of them, as there is in those of land animals, their sense of smell can be of very little use to them.

Q. Has not the contrary been said?

A. It sometimes has; but trout and salmon, that were supposed to have the most acute scent, were all the while unable to distinguish between a fly and an iron hook dressed with feathers, or between a piece of painted wood and a minnow. Land animals that follow their prey by the scent, never make those mistakes.

Q But sharks are said to follow ships in which there are sick persons, by the smell?

A. Sharks do follow ships whether they have sick on board or not; and if any thing is thrown overboard, they make a plunge at it, even if it is a cask or a bottle. The common by-word of "throwing a tub to the whale," (and the whale, as a warm-blooded animal, has far more sensation than fishes,) has more of philosophy in it than those statements.

Taste.

Q. Have fishes organs of taste?

A. They have tongues and palates; but these are covered with the same kind of cuticle that lines the rest of them internally, and have none of those papillæ which are characteristic of taste in land animals.

Q. Have they, then, no means of rejecting poisonous substances?

A. Taste is not a sure preventive of poison even in those animals in which it is the most perfect; and it is probable that fishes are poisoned in the gills, and not in the stomach.

Q. Then do none of the characters of fishes depend on their differences of taste?

A. None from which any useful conclusion can be drawn.

Touch.

Q. Have fishes any sense of touch?

A. Some of them—the common trout, for instance, appear to feel a pleasure in being tickled; but fishes in general have not the papillar surface of the skin which is understood to be more immediately the organ of touch.

Q. Have they keen feelings of pain?

A. In their bodies, generally, they appear to have very little: they bite almost immediately after they have been torn by a hook, unless that hook happens to lascerate the gills, or any part of the machinery by which these are worked; but when that is the case, their feeling of pain seems to be very acute.

HEARING.

Q. Have fishes any voice?

A. No animal but those that respire air by the mouth have any thing that can properly be considered as voice; and no sound of the voices of its millions of gilled inhabitants, ever comes to the surface of the waters; and when a shoal of cod is so numerous and thick that the sea is whitened by them for miles, not a sound comes from the vast assemblage, except when they rise to the surface, and splash there, the sound of which is of course no more voice than the splash made by a stone when it is thrown into the water.

Q. Do they not utter sounds of any kind?

A. Some fishes, when taken out of the water, force the air out of their gills with a sort of noise; and others, when depositing their eggs or spawn, produce sounds also; but with what part of their bodies, or for what purpose, is not known.

Q. Do they not hear sounds?

A. They do; though the precise way in which they do it is not very well known.

Q. Have they organs of hearing?

A. As far as observation has gone, all have internal organs of hearing; but those only that have not free gills, and a current of water passing by the mouth through these, in the act of breathing, have external organs.

Q. What are the external organs in those that have fixed gills?

A. They are apertures in the hinder part of the head; but so very minute that they are not easily detected. These little apertures lead to the internal organs, and are, no doubt, the passages through which sound is conveyed.

Q. What are the organs of hearing in other fishes?

A. They are tissues of nerves, which terminate in little bodies, more or less hard, that are adapted for vibrating.

Q. What is the medium of sound in fishes?

A. The water, of course, in all cases; but how the sense of sound, as different from that of the mere motion of the water, is conveyed, we have no means of knowing. The sense of hearing, is however so little developed in fishes, that it is not of much use in their natural history.

SIGHT.

Q. Have all fishes organs of sight?

A. The sight appears to be the sense that is most perfect in fishes, and the chief one on which they have to depend for the supply of their wants. The eyes of fishes are very large in proportion to those of land animals: the eye of a moderately sized cod is as large as that of a bullock.

Q. What number of eyes have fishes?

A. No red-blooded animal has more or less than two eyes; but those of fishes are very differently placed in the different species.

Q. How are they placed?

A. In some species of flounder, as in the halibut and the sole, they are both on the right side of the head; while in others, as in the turbot, they are both on the left side. In a few they are placed almost on the crown; but generally they are one on each side.

Q. Is there any thing peculiar in the external covering of the eyes of fishes?

A. Yes: in general, they have neither eyebrows nor eyelids, and they are covered over with the same cuticle as the body.

Q. What is the general form of a fish's eye?

A. The general form of all the parts is that of a hemisphere with the flat side outwards.

Q. Is that form better adapted to the element in which the animal lives, than an eye convex outwards?

A. Yes; it admits of more direct light into the body of the eye.

Q. Is there any thing further?

A. The external coat of the eye is much firmer than in land animals: in some instances it approximates to the texture of bone.

Q. Is not the *iris*, or part surrounding the pupil or sight of the eye, very beautifully coloured.

A. No. It is transparent; but the golden, silvery, or pearly surface of the choroid coat of the eye shines brilliantly through it.

Q. Is there any thing peculiar in the *crystalline lens*, or magnifying part of the eye?

A. It has much more magnifying power; that is, it is much thicker in the middle than the same organ in land animals, and it is more dense; so that that furthur increases its powers. This lens being composed chiefly of albumen, coagulates when a fish is boiled, and has some resemblance to a pea.

Q. As fishes have no eyelids, have they no means of closing their eyes?

A. In many species there is a sort of internal curtain that partially closes the pupil; and in one or two there is one which wholly does it. The changes of light to which the eyes of fishes are exposed, are not, however, so great as those that land animals must bear; and as the cuticle passes clean over the eye, there is no need of eyelids to moisten its surface.

Q. How are the eyes placed?

A. In the bony fishes, they are placed in cups or cavities, imbedded in gelatinous matter, to prevent them from being injured by shocks; but in many of the cartilaginous fishes, they are placed on stalks of cartilage.

Q. What advantage is gained by that mode of placing the eye?

A. It can be moved more rapidly and over a greater circumference, which is necessary, as those fishes have little or no power of turning the head by means of the neck.

Q. Then the eyes of fishes are of great use to them?

A. They are the organs upon which they chiefly if not wholly depend, both for obtaining their food and escaping from their enemies. The necessity that the fly-fisher is under of having his fly of the proper form and colour, and the fact of these being always enough to make the fish rise to it, are proofs that they judge from the sight alone.

SECTION IV.—MOTIONS OF FISHES.

Q. Has the general shape of a fish much to do with its motions?

A. The shapes of fishes are so very varied, that any one particular shape must have much less influence than those who found their notions upon the common principles of mechanical constructions suppose. We can, for instance, draw no conclusion regarding the motions of a living fish, as connected with its shape, from the shape of a piece of dead matter of a given size and weight, that can be most easily drawn or driven through the water.

Q. Why not?

A. Because in the case of a living animal, a great deal more depends on the energy of the moving powers, and the way in which these are arranged, than upon the mere shape of that which they move.*

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* Well-meaning, but weak persons, when they expatiate upon the beauty of creation, sometimes, absurdly enough, represent God as the imitator of man, as constructing fishes upon the same principle that men construct boats;

Q. What are the organs of motion in fishes?

A. The organs of motion are fins, and the powers by which these are moved are muscles, the same as in other animals.

Q. What is the general structure of a fin?

A. It in general consists of a number of rays, with joints, and divided towards their extremities, which are covered on both sides and united together by the skin. In some fins, however, there are rays without joints, which are termed spines. Some fins are wholly without rays, and thence called fleshy.

Q. Have all fishes the same number of fins, as all birds have the same number of wings?

A. No: both the number and distribution of the fins of fishes vary much in the different species; and as these are variations that are easily seen, and correspond with other qualities of the species, they are of much use in the classification of fishes: their names and situations should therefore be familiar to the student.

Q. What are the names and situations of the different fins?

A. 1. *Caudal*, or tail-fin. It is always articulated to the last vertebræ of the tail, consists of a number of rays, and has the extremity forked, or straight, or rounded.

Q. What is the position of the caudal fin?

A. It is always perpendicular in fishes, while it is

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whereas the imitation, so far as it goes, is quite the other way, and the moving power, "instinct with life," is altogether inimitable.

horizontal in the *cetaceæ;* so that a true fish is instantly known by the tail.

Q. What are the other fins?

A. 2. *Dorsal*, or back-fins. They vary very much, both in form and in number.

3. *Pectoral*, or breast-fins, generally one on each side, immediately behind the gill openings.

4. *Anal*, vent-fins, placed between the tail-fin and the vent, and varying in form and number.

5. *Ventral*, belly-fins, placed between the vent and the throat. They are never more than two; but they are differently placed, though always parallel to each other.

Q. Do the ventral fins get different names from their position?

A. Yes; when before the pectoral fins, they are called *jugular*, or throat-fins; when immediately under the pectoral, they are *thoracic*, or chest-fins; and when behind the pectoral, they are *abdominal*, or stomach-fins.

Q. To what are the bony or cartilaginous rays of the fins articulated?

A. The *caudal* always to the last vertebræ of the tail.

The *dorsal* to little bones that are attached by ligaments to the spinous processes of the back bone.

The *pectoral* fins are differently articulated. In the bony fishes, they are articulated to a bony girdle that surrounds the body immediately behind the head, and bears some resemblance to the *scapulæ*, or shoulder-bones in the mammalia. In the cartilaginous fishes, there are no such bones, and the pectoral fins are articulated to the spine by means of flexible cartilage.

Q. Does the pectoral girdle of bones answer any other purpose in the economy of the osseous fishes?

A. It forms a permanent edge from which the gill-lid may be opened, or against which it may be shut, which would not be the case were the part soft and destitute of bone.

Q. And that is not required in cartilaginous fishes?

A. Of course not, as they have no gill-lids that open and shut.

Q. To what are the ventral fins articulated?

A. To a set of bones that have some resemblance to the basin of the mammalia; but they are neither articulated to the spine, nor form a girdle round the body.

Q. How are these bones connected then?

A. When the fins are jugular or thoracic, the bones that support them are articulated to the pectoral girdle; and when the fins are abdominal, the bones are merely imbedded in the muscles.

Q. Are there any other prominent organs on the bodies of fishes besides their fins and skins?

A. Yes; some fishes have thread like members near the mouth, or on the head, which are sometimes quite soft, and have at others a single jointed ray of bone or cartilage. The uses of these parts are not known: they are not in themselves organs of touch.

Q. What is the general distribution of the muscles or moving powers in fishes?

A. As the tail fin is the principal organ by which fishes are moved forward through the water, and as the propelling motions of that are produced by different flexions or bendings of the spine, the chief arrangement of the muscles is along both sides of the spine, supported by the spinous processes.

Q. Does the motion resemble any artificial one?

A. It bears some resemblance to the *skulling* forward a boat by one oar placed over the stern, and worked from side to side; but it differs in this, that there is only one joint in skulling the boat, and the whole impulse is given at the point of the oar; whereas in the fish there are many joints, and the impulse is given along the whole line.

Q. What is the effect of this distribution of the impulse?

A. The different flexions may so compensate each other, that the fish can move forward in a straight line.

Q. What are the uses of the other fins?

A. The dorsal-fins keep the body upright; and the other fins chiefly correct the irregular or wriggling motion that it otherwise would have. When these fins are cut off from fishes that have them naturally, those fishes reel in all directions; but other fishes that never have them, can move with perfect regularity; so that if one part of the swimming apparatus be deficient, other parts can be so formed as to make up for it.

Q. Are the motions of fishes rapid?

A. In those that have the full number of fins, and the body of moderate length, as in the trout and salmon, the motion is often so rapid that the eye cannot follow it, and the fish darts as if shot from an engine:

but these rapid motions are not long continued. Other fishes will, however, swim at the rate of not less than eight or ten miles an hour for a succession of days, or even weeks.

Q. Is there any characteristic difference of fishes in this respect.

A. The fishes that breathe by the mouth and gills appear in general to move fastest for a short time, but to be most easily exhausted; while those that have the gills fixed, can continue much longer.

Q. Why should the former be sooner exhausted?

A. As they breathe by the mouth, it is probable that their exhaustion is similar to what is called, "losing wind" in land animals.

Q. Have we any parallel case in land animals?

A. Birds, whose respiration is not confined altogether to the bill and nostrils, but which receive air into other cavities of their bodies, do not lose wind, as is the case with the mammalia. Their fatigue seems generally to be muscular exhaustion; and that seems also to be the case with the cartilaginous fishes.

Q. Have fishes any other motion than swimming?

A. Many species can leap, some of them, as the salmon, to a considerable height, which they accomplish by bending the body, with the tail nearly flat on the water, and suddenly jerking straight; and some mud-fishes, found in New Holland, can leap by the action of their ventral fins, which are long and elastic. Others, by spreading a membranous fin on each side, can fly; and there is one species in the Indian seas, that can climb, chiefly by means of spines on its body.

Q. Have fishes any means of resisting the motion of the water in which they are, so as to be at rest, without exerting their fins to keep them so.

A. Yes; some fishes are furnished with suckers, by means of which they can attach themselves to stones, to the bodies of other fishes, or to any solid substance.

SECTION V.—RESPIRATION OF FISHES.

Q. You said that a fish *breathes water*, did you mean that that substance is decomposed by its breathing in the same way as atmospheric air is by the breathing of land animals?

A. Not exactly so; fishes cannot live in water from which the air is wholly excluded; they cannot breathe air but through the medium of water; and a fish is suffocated in air just as certainly as a land animal is in water.

Q. Are not there some differences in the rapidity with which this takes place?

A. Yes; cartilaginous fishes can live for some time out of the water just as reptiles can live some time in it; and osseous fishes die soon in the air, just as the mammalia and birds do when put under water.

Q. What are the organs of respiration in fishes?

A. In those that may be considered the more perfect* fishes, they are four in number. Gills, gill-openings, gill covers, and gill-flaps; but in many species the covers and the flaps are wanting.

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* When the word "perfect" is applied to any production of nature, it simply means, more perfectly adapted to certain circumstances.

Q. What are the gills?

A. They are bodies formed of a great number of fleshy threads, or fringes, among which the water passes when the animal breathes.

Q. How many of these organs are there in a fish?

A. There are generally four on each side, but in some species there are one or two half-formed ones on each side additional.

Q. Of what parts do the gills consist?

A. Of a curved support of bone or cartilage, articulated at the one extremity to the bones of the cranium, and at the other to the bones of the tongue. The inner or concave sides of these bony supports are of a white colour and smooth, the gill-fringes or vessels are attached to the convex or outer sides, and are, when the fishes are in health, of a red colour.

Q. What are the immediate consequences of this structure?

A. The bones or cartilages defend the delicate structure of the vessels from the current of water, the quantity of which can also be regulated by those bony portions being moved nearer or farther apart.

Q. What are the gill-openings?

A. They are openings behind the gills, out of which the water in general passes after it has supplied the blood in the gills with the requisite oxygen, and which also carry off the carbonic acid that is formed during the process.

Q. Where are those openings situated?

A. In the osseous fishes they are immediately in front of the thoracic bones, and below they approach very near to each other. In the fishes that have no gill lids, they are of smaller size and differ both in number and in situation. Thus there are seven on each side in the lamprey, and in the ling there is only one on each side.

Q. What is the form of the gill lid?

A. The gill lid is a covering of a firm but rather flexible nature, articulated to the bones of the head; forming a cover and support to the gills, and opening or closing them for the purposes of breathing: some have the surface of it smooth, others have it rough, and in some it is beset with spines. If the gill lids are kept closed for some time, so that the carbonic acid that is formed cannot escape, or if the water be made to pass in rapidly at the gill openings and out at the mouth, the circulation stops and the fish dies.

Q. What is the gill-flap?

A. An appendage resembling a fin, attached to the posterior edge of the gill lid.

Q. Of what use is it?

A. It appears to assist in producing a current through the gills, and it *may* allow the water to come in gently by the gill opening when the mouth is shut.

SECTION VI.—CIRCULATION OF FISHES.

Q. The blood of fishes is red, is it not?

A. Yes, it is red and cold, but it is not so abundant in quantity or so generally distributed as in land animals. The muscular structures of a fish may be wounded without bleeding.

Q. What is the system of circulation?

A. There is a heart with single openings contained in a cavity behind the gills. The auricle of this heart receives the blood as it returns from the system, transfers it to the ventricle, from which it proceeds by an artery to the gills, is diffused over their surface in very minute ramifications, is purified there; and from that it again is sent over the system by the systematic arteries.

Q. Then the gills partially serve the purpose of a heart?

A. They do. It is from the gills that the blood of a fish is made to circulate over the system, in the same way that that of a warm blooded animal is sent by the systematic ventricle of the heart. On that account, a wound in the gills of a fish, if it be of any great extent, is as fatal by bleeding to death, as a wound in the heart of a warm blooded animal.

Q. Is the surface which the gills of a fish presents to the action of the water and the air which the water contains, considerable?

A. Much more than one would suppose. Dr. Monro found the whole surface of the gills of a large skate, equal to that of a full grown human body; and the gills in skate are not so large in proportion, as in many other species.

Q. Then the pressure upon those delicate organs must be considerable?

A. Yes, supposing a skate of the same dimensions as that upon which Dr. Monro made his experiment, to be at the depth of a thousand feet below the surface of the sea, the whole external pressure of the water upon its gills, would be little short of five hundred tons, and as the resistance made must be the same, the delicate coats of the gills would be exposed to a total pressure of about a thousand tons.

SECTION VII.—FOOD OF FISHES.

Q. You mentioned that fishes appear to be rather deficient in the sense of taste, has that any influence in the choice of their food?

A. Of course, it leaves them a greater range than if their palate had the power of accepting and rejecting.

Q. Are their organs of digestion simple?

A. They are rather so; the food is in general dissolved in the stomach by a gastric juice; but in some instances where the food is shell-fish and the mouth not adapted for breaking the shells, the stomach is thick and capable of grinding them.

Q. What is the position of the mouth?

A. It is always across the body; sometimes in the front of the muzzle, as in the herring, sometimes under it, as in the shark, and sometimes twisted as in the flounder.

Q. What are the characters of the teeth of fishes?

A. They are very various, but they may in general be said to resemble the teeth of reptiles, much more than those of the mammalia; they are formed for seizing, but not for chewing; there are often many rows of them, on the palate as well as the jaws, to aid in the process of swallowing.

Q. Have none of them chewing teeth?

A. Not properly so called; but the species which feed upon the harder shell-fish, have teeth adapted for breaking the shells.

Q. Has any fish teeth out of the mouth?

A. The saw-fish has them on each side of an elongated snout.

Q. Is there any thing peculiar in the teeth of the shark tribe?

A. Yes; that tribe of fishes have the teeth fastened to the jaw bones by cartilages, so that they are moveable, and as they are in many instances toothed like saws, the fish can hold its prey with one part of the teeth, while it cuts and tears with the others.

SECTION VIII.—THE AIR-VESSEL of FISHES.

Q. As fishes when they are of different depths in the water, are subjected to very different degrees of pressure, have they any means of sustaining themselves at those depths, other than their muscular power?

A. Yes, many have, but not all; there is against the spine, in the anterior part of the abdominal cavity, a vessel called the air-bag, or in common language, the *sound*. In some provincial places, especially those inhabited by fishermen originally from Germany, it gets the more appropriate name of the *souim* or swim.

Q. Is it an important organ?

A. In the arts it is, and there is little doubt that it also is so in the economy of fishes, but its uses there are not so well understood, as one cannot follow fishes into the depths of the ocean, and study their economy there.

Q. What are its uses in the arts?

A. When the external pellicle is removed, the remainder is more pure animal gelatine than is found in any other organ; and thus it makes either a very palatable and nutritious article of food, or a fine transparent glue.

Q. From what fishes is it taken as an article of food?

A. Chiefly from cod and ling, whence it is called and known in commerce, by the name of "cod sounds."

Q. From which species is it taken for glue?

A. Chiefly from the sturgeon, but from any fish it would do. The vessels are cut open lengthwise, scraped, steeped in lime water to separate the oil, washed clean and dried, in which state they are the *isinglass* of commerce.

Q. And the uses of it in the natural economy of fishes is not known?

A. Our knowledge of them is very imperfect. We know that fishes that have an air-bag, cannot rise in the water if it be perforated; but all fishes that are found near the surface have not an air bag, and all fishes that have one do not rise habitually to the surface.

Q. Can you mention any instance?

A. The eel which generally remains at the bottom has an air-bag, and the mackerel, which swims rapidly near the surface, has none.

Q. Is it wanting in any natural sub-class of fishes?

A. Yes, in all them that have the gills fixed, and have neither gill-lid nor gill-flap; but no conclusion with regard to its use can be drawn from that, as some of these, such as the skate, keep near the bottom, while others, such as the sharks, swim near the surface.

Q. What is the action of the air-bag?

A. It or its contents has a power of expanding and contracting; when a fish is at a great depth, the bag is contracted to a fraction of the size that it would have had at the surface; and when the fish is rapidly drawn from a great depth, (as is the case in the deep-sea fishing for cod), the air-bag bursts, the contents escape into the abdomen and force the gullet and even the stomach inverted out of the throat.

Q. Is there any opposite effect?

A. Yes, when a fish has been long near the surface in hot weather, the air-bag loses its contractile force, and the fish cannot get down again.

Q. With what is the bag filled?

A. With air; but the composition of that air in the bags of fishes taken from different depths, is so different, that where the air comes from, and what purpose it serves, become curious questions.

Q. What are the differences in composition at different depths.

A. In a mullet taken at the surface, the contents of the air-bag was almost pure nitrogen, but the admixture of oxygen increased with the depth, till in that of a gurnard taken at deep water, the nitrogen had diminished to little more than a tenth of the whole, the rest being oxygen.

Q. What is the inference drawn from that?

A. That the air contained in the bag is not taken in by the mouth, or separated from the water by the gills, but that it is separated from the blood by the bag itself, and answers some purpose in the economy of the fish which is unknown, but which requires nitrogen at the surface, and more and more oxygen as the depth is increased.

SECTION IX.—REPRODUCTION OF FISHES.

Q. Are all fishes produced from eggs?

A. They are; but there are some very singular facts connected with the reproduction of fishes.

Q. What are some of them?

A. In the greater number of fishes, the production is by the union of melts and roes, which are deposited together in shallow water, near the sand; but in some the eggs are hatched within the mother, and the young break the membranous shells as they are born: in others there is only one sex.

Q. Which are those that deposit melts and roes?

A. Salmon, herrings, cod, and a great variety of others, some of which pass far up the rivers for that purpose.

Q. Which are some of those that bring forth their young alive?

A. Sharks, skate, and other cartilaginous fishes, and also some of the osseous ones.

Q. Which are only of one sex?

A. Lampreys, and probably also carp and whitings, with some others; but the subject is exceedingly difficult and not much known.

SECTION X.—ELECTRICITY OF FISHES.

Q. What is meant by the electricity of fishes?

A. Certain powers that fishes have of communicating to those who touch them, a shock, something resembling that produced by an electric machine or jar.

Q. By what part of the fish is that produced?

A. There are always peculiar organs for it, which are quite different in their structure from any other organs, and have no use, that has yet been discovered, other than the producing of this sensation.

Q. What may probably be the use of that power, to fishes in their natural state?

A. It may enable them to benumb and stupify those smaller fishes on which they prey.

Q. Are there many fishes that have this property?

A. Not many; the torpedo or cramp fish, is the only one that is met with in the European seas, and it very rarely occurs on the shores of Britain. The gymnotus, something in the form of an eel, is met with in the fresh waters of America, and three other species that are found in Africa, and in the Indian seas, are the only electric fishes at present known.

Q. Of what structure are the electric organs?

A. They consist of a number of pipes placed in close connection with each other, divided by numerous thin partitions and filled with a fluid.

Q. Does this electricity resemble that which is produced by artificial means?

A. It is communicated by the same conductors, and stopped by the same non-conductors.

Q. Is it voluntary on the part of the fish?

A. It must be so to a certain extent, for it is attended by a muscular effort; but the fish may be provoked to exert it so often as to become exhausted and die.

Q. Do the young fish have it as well as the full grown ones?

A. Spallanzani found that torpedos which had not left the egg, could give a small shock.

Q. Is it formidable to any other animal?

A. There are instances mentioned of bullocks and other animals, being numbed in the legs, and falling down and being drowned in the marshy rivers of America, from shocks given by the gymnotus.

SECTION XI.—DISTRIBUTION AND HABITS OF FISHES.

Q. What is the general distribution of fishes?

A. In the warmer waters the species are more abundant and the colours in general more brilliant; but the absolute quantity and the value to man, are perhaps as great in the cold latitudes.

Q. What are the prevailing colours of fishes in the warmer regions?

A. They are of all colours, some gold coloured and scarlet; and the scales are in many of the species larger than in the fishes of colder places.

Q. What are the prevailing colours in the cold seas?

A. Black and white with intermediate shades of blue and grey. Their scales are in general smaller, and their skins thicker, and more mucilaginous.

Q. What is the principal distinction of fishes as to their habitations?

A. Those that live in the salt water, and those that live in fresh.

Q. Which are the more numerous?

A. The salt water ones are, from the greater range of their habitations, mostly more numerous, and they are to the same extent more valuable.

Q. Is there any thing in the form that would enable one to distinguish between a salt-water fish and a fresh-water one?

A. There is nothing, though when the same kind of fish inhabits salt and fresh water by turns, one may tell from which it has been taken.

Q. Is there any difference in the flavour?

A. Yes. Salt water fish may in general be considered as richer in flavour than fresh water ones.

Q. Does salt water communicate a salt taste to fish?

A. No. Fish from the sea have no more taste of salt than those from the most limpid streams.

Q. Is it not singular that the salt sea should produce fresh fish?

A. Not more so than that a white lily should grow out of brown earth, or a black hen lay white eggs.

Q. To what place of the sea do fishes generally resort?

A. The chief places of their resort are currents, or rather the banks that are deposited where currents meet.

Q. Why should they prefer those places?

A. Because the currents bring a supply of food which they deposit there along with the other matter that form the bank.

Q. Are fishes distinguished from the part of the sea in which they are found?

A. Those that are found in the open ocean, and those only, are called *pelagic*, or " deep sea" fish, and those that are found near the land are called *littoral*, or " shore" fish.

Q. Are fishes also adapted to the various depths and bottoms of the sea?

A. No doubt they are, but the peculiarities of their adaptation are not very well known; and they may vary because fishes eat almost any thing.

Q. Does their form afford any guide to their habitation?

A. What one might term handsome-fishes, that is, those with regular elongated oval bodies, are general or occasional inhabitants of the deep water; and those that are flat or have their bodies of angular and irregular shapes, are inhabitants of more shallow or muddy water, or of the groves of sea-weeds, and inequalities of the rocks under water.

Q. Is there any difference in the qualities of fish taken from different depths, or off different bottoms?

A. In the same kind of fish, that from deep and clear water is always the finest flavoured and the most wholesome; and perhaps the deep water fish and the shallow water, and the clear water, and the muddy water, vary in the same way.

Q. Does there appear any reason for that?

A. The water which fishes breathe must have some effect upon their health in the same manner as the air has upon the health of land animals; and those which wallow in the mud must be fouler feeders than those that sport in the pure flood; the former may eat putrid substances, and substances that are tainted by metals, the latter can eat only substances that are alive, or at any rate that are purely animal or vegetable.

Q. Is there any other reason why fishes taken from deep water near rocks, should be in better condition than those taken from shallow water near sand or mud?

A. Yes, they are subjected to less fatigue; as the rocks find them shelter in storms, while the inhabitants of shallow waters are often so completely exhausted by their struggles against the motion of the waters in storm and tide, that they are sent lifeless on the shore.

Q. What degree of heat can fishes endure?

A. Species of gilthead has been found in springs where the temperature was as high as 100°; and some parts of the tropical seas that are shallow and have a white bottom, no doubt have the same degree of heat.

Q. Do not fishes migrate periodically from place to place?

A. They all of course frequent those places where they can get food; and those that live at other times in the deep water resort to the shallows in order to deposit their spawn.

Q. But it is said that many species of fishes, herrings for instance, make periodical journeys to different latitudes; as from the regions of the poles southward?

A. These stories are not true.

Q. But herrings do visit the shores, only at particular periods?

A. They do so, but they do it to deposit their spawn, and when that is done they return to their proper element, the deep water—the nearest deep water; and all fishes that deposit their spawn in the sand or mud, and leave it to be hatched by the action of the sun and atmosphere, follow nearly the same course.

Q. Then may some judgment be formed of the nature and depth of the sea outwards from the kind of fish that are found on the shores?

A. Yes. If herrings or pilchards come to the offing in fine condition, they are immediately from deep water; if cod and haddocks, they are from sea-banks; if soles and turbot, they are from banks nearer the land; and if flounders, they are from low and muddy shores.

Q. Then is it probable that those fishes that are found upon the shores only at particular seasons, would be met with in the deep sea at other seasons?

A. There is not the least doubt of it; only in their habits they are not so well known; the fishermen do not know so well how to catch them there; besides their boats and tackle are fitted only for short trips and small depths.

Q. Do the same individual fishes resort to the shores every year?

A. The fact has not been very well ascertained; but it is probable that they do not.

PART II.—CLASSIFICATION OF FISHES.

Q. What are the principal characters to adopt in classifying fishes?

A. The most general is the texture of the skeleton, from which we have the two sub-orders of CARTILAGINOUS fishes, and OSSEOUS fishes.

Q. Which character is next in importance?

A. That of the *gills*, which nearly but not altogether corresponds with that of the skeletons.

Q What is the difference?

A. All fishes that have an osseous or bony skeleton have the gills free or moveable; by far the greater number have a gill-lid and gill-flap, but there are a few with the lid without the flap, a few with the flap without the lid, and a few without both.

Q. And what are the distinctions with regard to the cartilaginous fishes?

A. Some have the gills fixed, and neither gill lid nor gill flap; others have the gills free, some with both lid and flap, some with one but without the other, and some without both.

Q. Then there will be eight divisions?

A. Precisely so: four in each sub-order.

Q. Is there any other general distinction?

A. Yes, the absence or presence of ventral fins and their situation when present, which, though apparently a trivial circumstance, forms orders that have other peculiar natural qualities in common.

Q. What are the names of the orders?

A. 1. *Apodal*, footless, when there are no ventral fins.

2. *Jugular*, when those fins are at the throat.

3. *Thoracic*, when they are on the breast.

4. *Abdominal*, when they are on the belly.

Q. Repeat the great lines of the system.

ONE CLASS.	*Fishes*, cold red blood, breathe water by gills.
TWO SUB-CLASSES.	1. *Cartilaginous*, with gristly bones. 2. *Osseous*, with hard bones.
FOUR DIVISIONS in each sub-class.	1. With gill-lid and gill-flap. 2. With gill-lid and not gill-flap. 3. With gill-flap and not gill-lid. 4. Without both—gills fixed, or gills free.
FOUR ORDERS.	1. *Apodal*, without belly fins. 2. *Jugular*, with these fins on the throat. 3. *Thoracic*, on the breast. 4. *Abdominal*, on the belly.

Q. Then there are thirty-two orders?

A. There are in the system, but there are not so many in nature, as some of the subdivisions have not all the varieties in the ventral fins.

Q. What is the next subdivision?

A. Into *genera*, of which there are about two hundred and twenty-five.

Q. Are these uniformly divided over the orders?

A. Very far from it, the thoracic and abdominal, hard boned fishes, with gill-lids and gill-flaps comprise three-fourths of all the known genera, that is, 169 out of 225.

Q. Are there many species?

A. Nearly fifteen hundred are known; and discovery is now and then finding out others.*

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* The utter impossibility of enumerating even the *genera* in such a way as that young persons would read it, need hardly be noticed.

SUB-CLASS I.—CARTILAGINOUS FISHES.

Q. What are the leading characters of these?

A. Their skeletons are never harder than gristle, and generally speaking they are more tenacious of life than other fishes; but they are very different in their characters and habits.

DIVISION I.

The gills fixed, and neither lid nor flap.

ORDER I.—APODAL.

Q. How many genera, having fixed gills without lid or flap, have no belly fins?

A. Three genera.

1. Lamprey,* *Petromyzon*, (stone-sucker,) with teeth within the sucker.
2. Pride, *Ammocœtes*, without teeth.
3. Hag, *Gastrobronchus*, one large tooth on the palate, body glutinous.

Q. What are some of their characters?

A. Some lampreys live in the sea, others in rivers, in form they resemble eels, have always seven gills on each side the neck, can adhere to substances by the mouth. The pride lives in the mud of rivers, and is not very common. The hag lives in the sea, is about eight inches long, and has no eyes. It enters the mouths of fish when on the fishermen's lines, and sucks their substance.

Q. Are there any jugular or thoracic fishes in this division?

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* That lamprey is not the *murena* of the Romans.

body, tail-fin ending in a long thread, found occasionally in the British seas.

DIVISION III.

Gills free, with a lid, but no flap.

Q. Are the four orders in this division complete?

A. No; the apodal, jugular, and thoracic are wanting, and the only one is

ORDER XII.—ABDOMINAL.

Q. What are the most important genera of that order?

A. It contains but two, *Polyodon*, of which hardly any thing is known, and

Accipenser, sturgeon, of which there are several species, highly valued for food; for their roes, which form a dish called caviar, and for their air-bags, which are the best isinglass.

Q. What are their habits.

A. They generally reside in the sea, but ascend rivers in great numbers to spawn. They are covered with osseous plates, the mouth is under the snout, and bearded in part, but without teeth.

DIVISION IV.

Cartilaginous, with free gill-lids and flaps.

Q. Is that division complete?

A. It wants the second order, the fourteenth in the system.

ORDER XIII.—APODAL.

Q. What are the characters of that order?

A. The fishes are of singular appearance, the greater part oval, or nearly globular, only one genus being much elongated. The greater part of them are natives of the warm seas.

Q. What are the genera?

A. 1. *Ostracion*, found in the Indian seas, has a sort of shell upon it, can be familiarized, and is much relished as food.

2. *Tetrodon*, saw-fish. These have the body round but wholly covered with spines in some of the species, and have the power of inflating the belly to a great size. One of them is electrical.

3. *Ovoides*, resembles the former in many points, but is little known.

4. *Diodon*, globe-fish, resemble the saw-fish, but have each bony jaw with only one point, instead of two, as in these. They are very spiny, and the species often have a fine colour. Poisonous: the gall of some, in very small quantity, producing instant death; but, clear of that and the other intestines, the fish may be eaten. Air-bag makes excellent isinglass.

5. *Spheroides*, resembles the former, but has no teeth; found in the Atlantic, but rare.

6. *Syngnathus*, pipe-fish, has the head long, the mouth small, without teeth, and with a lid. The body covered with osseous plates. The species are not well distinguished. Some of them are found in the British seas. Oviviparous.

ORDER XV.—THORACIC.

Q. What are the distinctions of this order?

A. The bodies are soft and oily, and have suckers on the under part. They are found in the sea, and sometimes in the mouths of rivers.

Q. What are the genera?

A. 1. *Cyclopterus*, the sucker, has sharp teeth in the mouth, and one adhesive sucker on the belly. Some of them melt in a few hours after death.

2. *Lepadogaster*, organs of adhesion double; four filaments before the eyes; found in the Mediterranean.

3. *Centriscus*, trumpet-fish; long snout, and jaws without teeth.

ORDER XVI.—ABDOMINAL.

Q. What are the abdominal genera?

A. 1. *Machrorinchus*, found in the Chinese sea.

2. *Pegasus*, found in most warm climates; very small, can use the pectoral fins as wings.

SUB-CLASS II.—OSSEOUS FISHES.

Q. What are the general characters of them?

A. Their bones are hard, their gills are free, and they are in general produced from eggs, that are hatched without any care from the parent.

Q Are they arranged into the same divisions as the former sub-order?

A. They are, though by far the greater part of them belong to

DIVISION I.

Bony, with gills, gill-lid, and gill-flap.

Q. Are all the four orders perfect in this division?

A. They are; but the greater number belong to the last two.

ORDER XVII.—APODAL.

Q. How many genera are in that order?

A. There are twenty-one.

Q. Which are the first three?

A. 1. *Cæcilia,* the blind-eel, has no fins, and an opaque skin over the eyes: resembles the hag, and perhaps should be classed with it.

2. *Monopterus* (single-fin), has a fin only on the tail, and the gill opening between the eyes: found in the Indian seas.

3. *Leptocephalus* (slender head), long and slender, with dorsal and anal, but no caudal or pectoral fins: met with in the South sea.

Q. What are the next three?

A. They are

4. *Gymnotus,* has dorsal and caudal fins, but no anal or pectoral fins; resembles an eel. There are several species, one of which, *G. Electricus,* gives shocks.

5. *Trichecus,* blade-fish, inhabits the warm latitudes. The common name expresses the shape. The sea species is electric, the fresh-water one not.

6. *Notopterus,* a native of the Indian seas, differs from the *Gymnoti,* in having a dorsal fin, and being very short.

Q. Which are three more?

A. 7. *Ophisurus* (serpent tail), form and habits of a snake. Abounds in the Mediterranean.

8. *Triurus*, bears some resemblance to a herring, but has the mouth drawn out into a tube. It is often found in the stomach of the tunny.

9. *Apteronotus*, has, instead of a fin, a filament on the back in the form of an arch, strung with twelve smaller ones, like a harp.

Q. Mention three more.

A. 10. *Regalecus*, king of herrings. Found in the north seas, body and tail very long, somewhat serpent-like, but has a fin on the tail.

11. *Odontaganthus*, the sardine, found on the north coast of South America, has a plate on each side of the under jaw. Is eaten.

12. *Muræna*, the eel. Many species, and very common; some produced alive, others not. Young often migratory in shoals. Much used as food, but not very digestible.

Q. What are three other species?

A. 13. *Ammodytes*, the lance, a very delicate fish, about four inches long, buries itself in the sand, and found by digging at low water, very common.

14. *Ophidium*, long and compressed, with large scales on the head, and a beard in some of the species, fins above, under, and on the tail, all united.

15. *Macrognathus*, fins not united; found in the Indian seas; eatable.

Q. What are the characters of the next three?

A. Some of them are more formidable than those of the order that have been named. They are

16. *Xiphias*, the sword-fish, in which the upper jaw has the form of a blade, and grows to the length of one-third the body. The body is sometimes nearly twenty feet long, so that the animal and its weapon are equally formidable.

17. *Makaira*, two lance-shaped shields on each side of the tail. Little known.

18. *Anarchicas*, wolf-fish, or cat-fish; head very short, teeth strong; lives on hard shell-fish, very common on the east coast, esteemed as food in the northern parts.

Q. Which are the last three of the order?

A. 19. *Comephorus*, great head and mouth, and filaments on the dorsal fin. Found only in Lake Baikal, in Siberia.

20. *Stromateus*, found in the Mediterranean and Indian seas. Body oval and compressed; colours beautiful; delicate eating.

21. *Rhombus*. The sides have that four-sided figure; body short. Found on the American shores.

ORDER XVIII.—JUGULAR.

Q. How many species are in that order?

A. Only eleven; but some of them are very curious, others very valuable.

Q. Which are the first four?

A. 1. *Murænoides*, resembling an eel, but with fins of one ray on the throat.

2. *Callionymus*, dragonet. Head larger than the body, eyes very brilliantly coloured, rays on the back

have a fancied resemblance to a lynx. Sexes in some of the species very dissimilar.

3. *Calliomorus*, an Indian genus, something like the former.

4. *Uranoscopus*, star-gazer. Head flat, and eyes on the crown, lies in the mud, and tempts small fishes with its filaments. Found in the Mediterranean.

Q. Which are the next three?

A. 5. *Trachinus*, weaver. A small mud fish, with spires on the head, and gill covers, and on the dorsal fin, the last considered venomous. Not numerous on the coast of England.

6. *Gadus*, cod. One of the most important of fishes.

Q. Are there more than one species?

A. There are many, and some of them are exceedingly numerous, and excellent food.

Q. Mention a few of the leading ones?

A. A few of the principal ones are,

Morhua, the common cod.
Æglifinus, the haddock.
Molva, the ling.
Brosme, the tusk.
Merluccius, the hake.

There are, however, very many species, all of them wholesome. The haddock and whiting are the best fresh; the cod and ling when salted.

Q. What are the remaining genera?

A. 7. *Batrachoides*, with flat head, large mouth, and a beard.

8. *Blennius*, blenny. A soft mucous fish, some of them are oviviparous.

9. *Oligopodus.* A fin along the whole back. Indian.

10. *Kurtus.* Body flattened, keeled. Indian. Lives on shell-fish.

11. *Chrysostomus* (golden streaked). Little known.

ORDER XIX.—THORACIC.

Q. You remember what Thoracic means?

A. That the fins below are on the chest; that is, just under the pectoral fins.

Q. And could you tell the order from the number?

A. Yes; when I took four from the number as often as I could, if there remained one, it would be *apodal;* if two, *jugular;* if three, *thoracic;* and if 0 *abdominal.*

Q. Repeat the numbers of the orders, with their characters from the fins?

A. *Apodal,* 1, 5, 9, 13, 17, 21, 25, 29.
Jugular, 2, 6, 10, 14, 18, 22, 26, 30.
Thoracic, 3, 7, 11, 15, 19, 23, 27, 31.
Abdominal, 4, 8, 12, 16, 20, 24, 28, 32.

Q. Are there many genera in the nineteenth order?

A. There are ninety-eight, but the species in some of them are but little known?

Q. Which are some of the more interesting genera?

A. *Scomber, Echeneis, Coryphæna, Macrourus, Sparus, Perca, Mullus, Zeus,* and *Pleuronectes,* are some of the most celebrated; but the whole order is interesting.

Q. What is *scomber?*

A. Scomber is the mackerel genus, one species of which, with its thin and beautifully mottled skin, is s well known, so abundant, and often so cheap in the summer. Though they frequent the shores at some seasons, they are pelagic fishes, and some of the species are very useful to sailors in long voyages. They feed at the surface, and are very voracious and easily caught. The tunny, one of the genus, weighs as much as six hundred pounds.

Q. What is *Echeneis?*

A. The name means "sticker to ships," which the fish can do by a sucker on the head, and that is the most remarkable thing about it. It is the ancient remora.

Q. What is *coryphæna?*

A. The coryphene, or "dolphin" of the ancients. It is about three feet long, with an obtuse head and one immense dorsal fin. Its colours are very beautiful, but they vary and fade as it expires. It is a pelagic fish, lively, voracious, easily caught, and delicious eating. It is found in all the great oceans.

Q. What is *macrourus?*

A. It is the rock salmon of the northern nations, a very valuable fish in Greenland and Iceland.

Q. What is *sparus ?*

A. The gilt-head, a very numerous genus, some of which have a remarkable power of giving light. There is one species not uncommon on the coasts of Brazil, three or four of which, swimming together, would give as much light as would enable one to read in a dark night.

Q. What is *perca?*

A. The perch; a well-known, beautiful, and useful inhabitant of ponds and lakes, and also of the sea.

It is a very light and wholesome food, and good isinglass may be made from it.

Q. What is *mullus?*

A. The sur-mullet, of which there are many species. The colours of the red sur-mullet are very brilliant, and the changes which they undergo while the fish is dying is most singular. The Romans used to exhibit to their guests the splendid dying agonies of the sun-mullet as a zest to the appetite with which they ate it afterwards?

Q. What is *zeus?*

A. The doree, of which there are three species, all rather singular in their shape, and of which the common doree, or "John Dory" is esteemed by epicures.

Q. What are the others?

A. They are both Indians. One has long filaments to the dorsal and anal fins, which it is said to coil round the stems of aquatic plants, and by jerking them suddenly, shake flies and other insects, on which it feeds, into the water.

Q. Is there any thing peculiar about the other one?

A. Yes. Its mouth is lengthened and tubular, and it is said to use it in shooting flies with drops of water.

Q. Are not there some other species that shoot flies in this manner?

A. Yes; the *chætodon rostratus* of the West Indies?

Q. What sort of fish are the chætodons?

A. They are a numerous genus, beautiful in their colours, singular in their forms, and many of them excellent food. Their teeth are long and flexible like bristles, whence they get their names.

Q. What is *pleuronectes*?

A. The flounder tribe, which have the mouth crooked, and both eyes on one side of the head, some on the left and others on the right.

Q. Are they very numerous?

A. They are both numerous and abundant, and many of them are very excellent eating.

Q. What places do they inhabit?

A. They are all *littoral* fishes, and some are found in fresh water. They prefer a sandy bottom, and are the most numerous in the cold latitudes.

ORDER XX.—ABDOMINAL.

Q. Are there many genera with gill-lids and gill-flaps that have the ventral fins behind the pectoral?

A. There are sixty-four genera, some of which contain a great number of species, and many of them are highly useful.

Q. Is there any thing peculiar in this order as contrasted with the one immediately preceding?

A. There is. The preceding order contains the fishes residing wholly in the sea that are most valuable as food, and this one contains the most valuable that reside wholly or occasionally in fresh water.

Q. Which are some of the more important genera?

A. Many more are important, but the following are some of the most celebrated: *silurus*, *salmo*, *esox*, *mugil*, *exocœtus*, *polynemus*, *clupea*, *clupanodon*, and *cyprinus*.

Q. What is *silurus?*

A. The silure a large fish found in the great rivers of Europe, Africa, and Asia. They have filaments at the mouth, and wallow in the mud.

Q. Are there more than one species ?

A. There are several.

Q. What size do the largest ones attain ?

A. Fifteen feet in length, and they weigh as much as three hundred pounds.

Q. Are they good food?

A. They are white, fat, and taste something like eels, but like those they are not very easily digested.

Q. Are they good for any other purpose?

A. The air-bags make good isinglass.

Q. Are any of them to be found in England?

A. Not in any part of the British islands, but they might be imported, and no doubt would thrive.

Q. What is *salmo?*

A. The salmon, one of the most important of all the genera.

Q. Are there many species?

A. Very many, perhaps not less than forty, but they are not very clearly defined.

Q. Which is the most important species ?

A. *Salmo salar*, the common salmon, which is found in all the rivers of the cold and temperate latitudes, into which it migrates to spawn, and it is always in the better condition the nearer the sea it is taken.

Q. What is the external appearance of the genus ?

A. They are the handsomest in their form of any fish, and their motions are very rapid and graceful.

Q. What is *esox?*

A. The pike, of which the common pike or jack, that is found in all the lakes and slow-running waters of Europe is the best known.

Q. What is the character of the pike?

A. It is any thing but a mild one: armed with strength and formidable teeth the pike preys indiscriminately upon fishes, reptiles, and the young of birds, and instances have been mentioned of its killing ducks and geese.

Q. Is it esculent?

A. It is eaten, but it is dry and not very good, and the caviare made of the roe is said not to be wholesome.

Q. Are there more species than one?

A. There are some sea species, one of which, the gar-fish, comes to the shores to spawn just before the appearance of mackerel. The flesh of it is good for nothing, and the bones boil green.

Q. Is there any other sea species?

A. Yes, there is, *esox gladius*, which is good food and easily caught, but it is not found on the European shores.

Q. What is *mugil?*

A. The mullet, which is found in most seas, and enters rivers to spawn like the salmon; there are several species, most of which are excellent eating.

Q. What is *exocætus?*

A. The flying-fish of which there are several species which have the power of flying by their fins. They have the air-bag very large. One species found in the Atlantic and Mediterranean, resembles a herring and is delicate eating. The spawn of some of them is said to be caustic.

Q. What is *polynemus*?

A. A fish of the warm latitudes that has spines near the ventral fins. The most celebrated species is found in the Ganges, and called the mango fish.

Q. What is *clupea*?

A. The herring, which, from its wholesomeness and the numbers that are caught, is one of the most valuable of fish.

Q. Are there any other genera than the common herring?

A. The sprat and the shad. The fry of the latter is "white bait," more celebrated than valuable.

Q. What is *clupanodon*?

A. The pilchard, which resembles the herrring, but differs from it in having no teeth, and in some other particulars. In the British seas it is found farther to the south.

Q. What is *cyprinus*?

A. Carp, of which there are many species much esteemed in river and pond-fish. They are easily tamed. The scales of some of them are used in imitating pearls.

DIVISION II.

Gills free, and gill-flaps, but no gill-lid.

Q. Are all the orders complete in this division?

A. No, there is only one species.

ORDER XXI.—APODAL.

Sternaptyx, with a compressed body, transparent on the under part, and one dorsal fin. Native of Jamaica.

DIVISION III.

With gill-lid, but no gill-flap.

Q. Are the orders perfect there?

A. No, there are only two orders, and one species in each.

ORDER XXVII.—APODAL.

Q. What is the genus?

A. *Styliphenos*, with only three gills on each side, a fold in the neck, the body long, spines on the tail fin.

ORDER XXVIII.—ABDOMINAL.

Q. What are the genera in that order?

A. Only one genus, *Marmyrus*, of which there are nine species, inhabitants of the Nile.

DIVISION IV.

Without gill-lid or gill-flap.

Q. How many orders are in that division?

A. Only one.

ORDER XXIX.—APODAL.

In which there are five genera.

Q. Which are the genera?

A. They are these.

1. *Murænaphis*, the *murena* of the Romans, which Vedius Pallio fed with his condemned slaves; lives in the sea, or in fresh water; easily tamed; resembles an eel except in the gills.
2. *Gymnomuræna*, without pectoral, dorsal or anal fins.
3. *Muræna-Heuna*, no fins, cylindrical, glutinous; from the Strait of Magellan.
4. *Shap branchers*, without fins or scales, cylindrical, the snout pointed. A native of the East Indies.
5. *Unibronchopertera*, one gill-opening; serpent-shaped, but with a fin round the tail. Native of the fresh waters in Surinam.

APPENDIX.

LIST OF BRITISH FISHES.

Q. ARE the British species of fishes numerous?

A. They are in all about 190 species, of which 48, or about a fourth, of the whole, are cartilaginous, and the rest bony.

Q. Are they equally distributed on all the coasts?

A. Of course not; the fishes of the warm countries are more common visitors of the southern coasts of England; and those of the polar seas of the north of Scotland.

Q. Are there any other circumstances that modify the distribution?

A. The pelagic fishes are of course most abundant on the bold shores where the water is deep, and the shore fishes in the bays and on the shallow shores.

Q. Which are some of the best frequented places?

A. The mud banks at the mouth of the Thames are very favourable for various kinds of flat-fish; the great banks that lie between the east coast and the opposite shores of Holland and Germany, are frequented by large shoals of the cod tribes; herrings are met with on the deep shores and in the deep estuaries; pilchards on the south coasts; salmon in the estuaries of the rivers; and mackerel in the clear water.

I.—CARTILAGINOUS FISHES.

Q. ARE there many genera of these?

A. There are twenty-four.

Q. Which are the British fishes of the first order?[*]

A. The lamprey and the hag.

Q. Are there more than one species of the lamprey?

A. There are three.

1. The lamprey, in all the great rivers.
2. The lesser lamprey, in many of the small rivers and brooks.
3. The pride, or lampern, in a few of the rivers of England, especially those of Oxfordshire.

Q. Where is the hag found?

A. It is not very common on any part of the British coast; but it is most frequent on the east.

Q. Are there many of the fourth order?

A. The ray, the torpedo, the shark, the angel-fish, and the sea-snake.

Q. Where are the rays found?

A. They are found on all parts of the coast; and there are fifteen species of them.

Q. Which are the most common?

A. The common or grey skate, the white skate, and the thornback. The sting-ray is common on the south shores, but very rare on the north.

Q. Is the ray that furnishes shagreen common?

A. No; but it has been met with on the coast of Yorkshire, and also on that of Devon.

Q. Is the torpedo common?

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[*] This brief list of British fishes may be made a useful exercise on the classification, by making the pupil repeat the characters of the orders.

A. No, it is very rare, and met with only on the south coasts of England and Ireland.

Q. Are the sharks abundant?

A. The great white shark is occasionally met with on all parts of the coast; and smaller ones, called dog-fish, beagle-fish, fox-fish, and other local names, are much more common.

Q. Is the angel-fish common?

A. It is found in many places, but not in considerable numbers. From its shape it is sometimes called the fiddle-fish.

Q. Is the sea-snake numerous?

A. Only one specimen has been seen, a very large one, which was cast ashore in Orkney, in a mutilated state, in 1808.

Q. Are there many British fishes of the sixth order?

A. The common angler, or fishing frog, is abundant on all parts of the coast; and there are one or two species occasionally met with on the south-west.

Q. Which is the next order?

A. The eighth, of which the northern sea-monster is sometimes met with on the Scottish coasts, but not on those of England.

Q. What are the British fishes of the twelfth order?

A. Only the sturgeon, which is occasionally taken in the salmon nets in the great rivers.

Q. Which are the genera of the thirteenth order?

A. The sun-fish and the pipe-fish; of the first of which there are three species, and six species of the last.

Q. Which are the sun-fish?

A. The common sun-fish, the oblong and the globe; the second of which weighs sometimes 500lbs.

Q. Which are the pipe-fish?

A. The shout and the needle, very common in sea-weeds; the deep-water, found among the shoals of sprats; the long and the snake, the last of which brings forth its young alive.

Q. Are there any of the sixteenth order?

A. There are three—the sucker, the small sucker, and the trumpet-fish; and there are several species of the sucker, but with the exception of the common lump sucker are rather rare.

Q. Which are the most valuable of the cartilaginous British fishes?

A. The rays, which are very abundant and very wholesome; the sharks, or those which are called dog-fish, are probably the next in value. Sturgeons are not so abundant as to form an article of separate fishery.

II.—Osseous Fishes.

Q. You said that the British species of these were the most numerous?

A. Yes; they are about three times as many.

Q. And are they valuable in an equal proportion?

A. They are much more so.

Q. Which is the first order of Osseous Fishes?

A. The seventeenth order in the system.

Q. Are there many British genera of that?

A. The blade-fish, the eel, the launce or sand-eel, the sword-fish, and the wolf-fish or cat-fish, with some other reputed ones of very rare occurrence.

Q. Are any of those that you have mentioned rare?

A. The blade-fish is very rare; only one specimen is mentioned. The sword-fish is also very rare; but specimens, fifteen feet long, have been met with.

Q. Are eels numerous?

A. They are, both the common or fresh-water eel, and the conger or salt-water one.

Q. Are the common eels always stationary in fresh-water?

A. No: in some rivers they migrate to the sea in autumn, and return again in the spring.

Q. When are they supposed to be in the best condition?

A. When they are leaving the fresh-water; which is contrary to the habits of salmon, and most other migratory fish.

Q. Is the wolf-fish rare?

A. It is plentiful in the northern parts of the island.

Q. Are there many genera of the eighteenth order?

A. Not a great many; but some of them are very abundant and valuable.

Q. Which are the genera?

A. The weever, the dragonet, the blenny, and the cod.

Q. Where is the weever found?

A. On the English coasts; it is not very often brought to market.

Q. Is the dragonet equally rare?

A. No. Both it and the blenny are more numerous; but they are of little value.

Q. Are there many species of cod?

A. There are many, and, besides the species, they are formed into five sub-genera.

Q. Which are the distinctions of these?

A. Some have only one dorsal fin, some have two, and some three; and some are bearded—that is, have fleshy appendages to the mouth—and others not.

Q. Which have but one dorsal fin?

A. Only one species, the *tusk*, which is very plentiful about the Shetland isles, but rarely found further to the south.

Q. Which have two dorsal fins, and the chin beardless?

A. Only the hake, which is confined to the west coast of England, and the south-east of Ireland. It is a coarse and insipid fish.

Q. Are the bearded ones with the two dorsal fins more abundant?

A. They are more generally diffused, and also more valuable.

Q. Which are some of them?

A. 1. The ling, of which great numbers are salted in the northern parts of the country. The body is longer, and also thicker in the flesh, than that of the common cod.

2. Burbot, which is a fresh-water fish of very delicious quality, but confined to a few of the rivers of England.

3. Five-bearded cod; an English species, found on the shores, but not very abundant.

4. Three-bearded cod; found on the rocky coasts.

5. Silvery cod; found on the west of England, and bearing a considerable resemblance to the former.

Q. Which are the beardless species with three dorsal fins?

A. There are four of them—

1. The whiting; found on most parts of the coast. Rather soft and insipid. Best in the spring.
2. The cole-fish; found mostly in the north. A very coarse fish, except when small.
3. The pollock; on the English coast, and west of Scotland.
4. Green-cod; in the northern parts. Not very common.

Q. Are there many bearded ones with three fins on the back?

A. There are seven species; but five of them are not very common, or much sought after.

Q. Which are these?

A. The common cod, the haddock, the speckled cod, the poor, the dorse, the bib, and the pout.

Q. Which are the more abundant species?

A. The common cod and haddock.

Q. Where are the common cod found?

A. They are very generally diffused, and exceedingly numerous. The Scottish coasts, especially the banks between the western isles, are the best British stations for them. A great number of people are employed in the capture of them; and as they are found every season, they form a-certain, as well as a profitable employment.

Q. In how many ways are they sent to market?

A. They are sent fresh for local supply to places near which they are caught; they are salted wet, and also dry, in which last state they bear to be carried to a great distance.

Q. Is haddock equal to cod?

A. When very fresh, and in the best condition, it is much superior; but it is not so generally diffused, or certain in its appearance, and does not bear to be salted, so that it is not so valuable for general purposes?

Q. Is it never prepared with salt?

A. Sometimes; but it is inferior to cod when smoke-dried; when fresh, it is very delicate, but loses its flavor when carried to a distance.

Q. Are there many of the nineteenth order?

A. They are numerous; and though none of them are so valuable as the cod, some are still of considerable importance.

Q. On what coasts are the greater number of that genus found?

A. On the coasts of England.

Q. Enumerate the principal ones that are so found?

A. 1. The scale-foot; 2, the red-band fish, on the coasts of Devon. Rare.

3. Bullhead, in clear streams in England.

4. The red gurnard; 5, the piper gurnard; 6, the sapphire gurnard; 7, the lineated gurnard; 8, the smooth gurnard: on the west and south of England.

9. The banded gurnard, on the east.

10. Striped sur-mullet; seven or eight species of wrassee; four species of gilt-head, and the doree, on the coasts of England.

Q. And are these to be considered as rare?

A. In general they are

Q. Are there any of the order found in Scotland, and not in England?

A. One species of gilt-head, the opah, and perhaps a few others.

Q. Which are common to the two countries?

A. The perch, though not found in the northern parts of Scotland; the mackerel, and some others.

Q. Are there not some flat fish belonging to the order?

A. Yes, the numerous genus of flounders, some of which are found in fresh water, and others in the sea; but generally speaking in shallow water.

Q. Is there any general distinction of the flounders?

A. Yes, some have both eyes on the left side of the head, and some both on the right side.

Q, Which are those of the former class?

A. There are five of them:

1. Turbot. Very generally diffused, and much admired.
2. Brill. Not so common on the Scottish coast as the English.
3. Whiff. On the English shores.
4. Spotted flounder. On the coast of Shetland.
5. Cyclops flounder. In the Irish sea.

Q. Which have the eyes on the right side?

A. There are about nine species, besides some varieties arising from colour.

Q. What are the species.

A. 1. Holibut, which is very common.

2. Sole, which is also common, although neglected in the north.
3. Dab, or salt-water flounder.
4. Common flounder, very common, and many varieties.
5. Plaise, very common.
6. Smear dab; 7, smooth dab; 8, variegated sole; and 9, lantern-fish, not so common.

Q. Are there many British genera of the twentieth order.

A. Yes, they are numerous, and some of them are very important.

Q. How many genera are there?

A. There are fourteen, and they contain 42 species.

Q. Which are the first two?

A. They are—

1. Loche, two species: common loche, found in rivers all over the country; armed loche, only in England. Rare.
2. Salmo, eight species.

Q. What are these?

A. 1. The river trout; common in most streams, but varies much in colour, size, and quality.
2. Salmon-trout; sea-trout or bull-trout; migrates between the rivers and the sea.
3 Grey trout; in streams, not so generally as the common trout.
4. Red belly; in mountain lakes.
5. Char; in large lakes on the central and southern parts of the island.
6. White; in some of the Cumberland rivers.
7. Sewin; in fresh water in Wales.

8. Salmon, the most valuable of them all; migrates between the rivers and sea. Sometimes weighs 50 or 60 pounds.

Q. Which is the third genus?

A. The smelt, found in estuaries.

Q. The fourth?

A. Coregonus. Of which there are at least two species.

1. The grayling; in some English rivers, also in Orkney.
2. The guiniad; in lakes. The fresh-water herring of Loch Lomond, and the juvangis of Lochmabin supposed to be the same.

Q. Which is the fifth genus?

A. The pike, of which there are two species, the pike in fresh water, and the gar-pike in salt.

Q. The sixth genus.

A. The gar-fish; on the south coast of England; rare in Scotland.

Q. Which is the seventh?

A. The saury; on the coasts, rather rare; called the Egyptian herring.

Q. The eighth genus?

A. The argentine; found on various parts of the coast, but not common.

Q. The ninth?

A. The atherine; on the shores and in estuaries. Very delicate. The tenth is the common mullet; in estuaries. The eleventh, the flying-fish, has been seen on the Welch coast, but very rarely.

Q. Which is the twelfth genus?

A. The herring, containing four species.

1. The common herring.

2. The sprat.
3. The shad, when young, white-bait.
4. The anchovy; on the south and west coasts, rare.

Q. Which is the thirteenth?

A. The pilchard, met with on most coasts, but in numbers only on the south-west.

Q. Which is the last genus?

A. Cyprinces, the carp, of which there are two divisions, one bearded, and the other not.

Q. Which are the bearded ones?

A. They are—

1. Carp, an excellent fish, but a native of warm countries, and will not breed in Scotland.
2. Barbel; in the deep parts of English rivers.
3. Gudgeon; abundant in English lakes and rivers. Doubtful if found in Scotland.

Q. Which are the beardless ones?

A. They are—

1. Minnow, common in gravelly streams.
2. Dace, in English rivers only.
3. Roach, in England and the west of Scotland.
4. Crucian, in ponds in the south of England.
5. Rudd, in the English lakes.
6. Chub, in deep parts of English rivers. Very rare in Scotland.
7. Red-eye, in English lakes.
8. Bream. Lakes and deep pools in England and Ireland; in some lakes in the south of Scotland.
9. Bleak, in English rivers, not found in Scotland.
10. Gold-fish, in some places of England, will not breed in Scotland.

Q. What sorts of fishes are chiefly used in ponds?

A. Fresh-water fish, if the ponds are fresh-water.

Q. What sorts are best?

A. Those that do not naturally live in running water. Such as pike and perch, and the lake varieties of trout.

Q. Are not salmon bred in ponds?

A. No. Salmon migrate to the sea, and do not breed if prevented from going there.

Q. Are there no salt-water ponds artificially formed?

A. A few in some parts of the country, and more might be made with advantage.

Q. What fishes have been kept in those ponds?

A. Most of the cod tribe, salmon trout, and various sorts of flounders.

Q. Do they find their own food in the ponds?

A. No; they are generally fed with sand-eels and shell-fish.

THE END.

LONDON:
HENRY BAYLIS, JOHNSON'S-COURT, FLEET-STREET.

SAURIA
CHELONIA
BATRACHIA
OPHIDIA

PINNOCK'S

CATECHISM

OF

ZOOLOGY.

PART 4.

REPTILES.

LONDON.
PRINTED FOR WHITTAKER, TREACHER, & Co.
AVE MARIA LANE.
1831.

NOTE.

In this little work, instead of repeating the mere marvels of the Science, such as the rapacity of the crocodile and the alligator, the crushing powers of the boa, or the deadly poison of the cobra and the rattlesnake, it has been thought more useful to explain the general characters of the class; and to describe particularly those members of it that are natives of Britain, respecting some of which there are vulgar errors, which often fill young minds with very groundless terrors and antipathies, matters that should be especially guarded against in the instruction of youth.

The great outlines of the system that have been adopted, are those of Dumeril, the pupil and assistant of the illustrious Cuvier; but some of the details are from other authorities.

CATECHISM OF ZOOLOGY.

PART IV.

HERPETOLOGY, OR REPTILES.

CHAPTER I.

INTRODUCTION.

Q. What is the meaning of Herpetology?[*]

A. That branch of natural history which describes the appearances and habits, and explains the nature of that class of animals to which the name of reptiles is given.

Q. What are the general characters of that class of animals?

A. The most distinguishing characters that belong to the whole class, and which mark them from all other animals are these: they have *vertebræ*, or back-bones; they breathe or respire by means of lungs; their blood is cold; they are destitute of the external coverings of hair or feathers; and the females have no teats for suckling their young.

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[*] *Herpetology*, from the Greek ἕρπετος, or reptiles, (from ἕρπω, " I crawl, or creep,") and λογος, an explanation—the explanation of crawling or creeping animals.

Q. What are some of their general habits?

A. They can exist much longer without breathing or without food than the warm-blooded animals; they suffer much less from wounds and other injuries, having the faculty of reproducing a whole member, as a limb or an eye, when it is taken off, which is not the case with the warm-blooded animals; they are slow of growth, but live to a very great age; and they appear to have the principle of life in a state in which it can accommodate itself much better to circumstances than in the warm-blooded animals. They are said to be lower in the scale of animated beings, inasmuch as they can obey the laws of inorganic matter with less injury to themselves.

Q. How does that appear?

A. In many instances; but one of the most remarkable is that of heat. A quadruped or a bird acquires heat for itself by its breathing and the rapidity of the circulation of its blood, the heat always being greater in proportion to the rapidity and effort with which those functions are exercised. Thus a warm-blooded animal can preserve its heat when the temperature is so low that it freezes water, and would congeal the fluids of the animal were it not for this power of generating heat. Reptiles, being destitute of this power, are more affected by the temperature. Long before that sinks so low as the freezing point of water they become dormant, and if the cold were much greater than that, they would be frozen.

Q. Has that much effect upon their distribution?

A. Of course it has. It confines them chiefly to the warmer parts of the globe. Those that inhabit the water can exist through the winter in higher latitudes; but those that live wholly on land bury themselves when the weather begins to get cold, and do not make their appearance again until the season is warmer.

Q. Then some of them are inhabitants of the land and others of the water?

A. They are; but those that live chiefly in the water and find their food there, do not breathe in the water, that is, they do not separate the air which they require from the water, they rise to the surface and breathe it as air; though from the length of time that they can exist without breathing, they can remain so long under the water as that those who are not acquainted with their structure and habits might suppose that they perform all the functions of life there.

Q. Do the animals of this class ever get any other name?

A. They are also called *amphibia*;[*] but the name is not descriptive of their true character.

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[*] *Amphibia*, from the Greek Αμφιβιος, living in both, animals that can live equally well in the air and the water. There are not, strictly speaking, any such animals in nature. There is one set of apparatus, *lungs*, by which animals are fitted for breathing "free air," that is air in its dry state; and other animals fitted with *gills*, by which they can breathe air as mixed with or decomposed from water, but the two are not interchangeable. There are many forms of lungs and also of gills; but still the whole

Q. Is the name reptiles descriptive of the class?

A. Not perfectly so, though it does not, like amphibia, include that which is not true in every case. Many of the reptiles creep, but others can swim, others again leap, as the frog, some can dart themselves to a considerable distance, and some can fly.

Q. Is there any common resemblance among the members of the class?

A. Scarcely any; their appearances are very varied.

Q. Are they a handsome looking class of animals?

A. They are generally considered as quite the reverse, but some of them are graceful in their forms and have beautiful colours.

Q Are they dangerous animals?

A. Some of them are, from their strength, and others from the poison with which they are armed. The crocodiles have most formidable jaws. Some of the larger serpents can coil themselves round even large animals, and crush their bones, while others of the serpent tribe have poisonous fangs, with which they kill their prey.

Q. Then they live upon animal substances?

A. In general they do, though some live upon vegetables. The largest ones generally live upon small quadrupeds and birds, and the smallest upon insects.

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that merit such appellation form a distinct class. In certain ones (as in that of the reptiles in water) the animal can live a long time in that which is not its *element*, but in no case do lungs breathe water or gills dry air.

Q. Which are the principal families or orders in the class of reptiles?

A. They are divided by the most eminent naturalists into five orders, *Chelonians*, *Saurians*, *Ophidians*, and *Batracians*.

Q. What is the popular name of the *chelonians*?

A. *Tortoises*, and the name of the order is from the Greek χηλωνη, tortoise.

Q. Are any of that order natives of England?

A. None of the land ones are natives, but a specimen is here and there domesticated. The sea ones sometimes come on the shores, but very rarely.

Q. What are the principal characters of the chelonians or *chelonia*?

A. They will be more particularly mentioned afterwards, but the leading ones are a round or oval body, arched above, and covered with a shell, four feet, and the mouth destitute of teeth.

Q. Are any of this order hurtful or dangerous to man?

A. Many of them are highly useful, but not one is possessed of any means of doing the slightest injury.

Q. What is the common name of the *saurians* or *sauria*?

A. *Sauria* is the Greek name of a lizard (Σαυρος) which means an animal with a tail, or a long tail.

Q. What are the principal characters?

A. The body is generally more elongated than in the tortoises, and destitute of shell; the toes have claws, and the jaws are armed with teeth.

Q. Are any lizards natives of Britain?

A There is one, of which varieties are mentioned, but somewhat obscurely.

Q. Are any of the order dangerous?

A. Some of the larger ones are on account of their bite, but none of them are poisonous.

Q. What is the common name of the *ophidians* or *ophidia*?

A. It is the Greek name for *serpents*, or animals without feet.

Q. What are their general characters?

A. Their bodies are very long, and without feet, and the jaws are furnished with teeth.

Q. Are there any other animals that resemble serpents in form?

A. Eels have some external resemblance to serpents, but eels are fishes, they have fins for swimming, and they breathe in the water.

Q. Are any of them dangerous to men?

A. Some might perhaps be from their size and strength, and others are from their poison; but by far the greater number are perfectly harmless.

Q. Are any serpents natives of Britain?

A. A few species, but with one exception these are are quite harmless, and that one is not very formidable.

Q. What is the common name of the *batracians* or *batrachia*?

A. It is named from (Βατραχος) the Greek name for a frog.

Q. What are the general characters of the order?

A. The general characters are—the body naked without any shell or scales, and the feet without claws; but in many of their other characters they vary very much.

Q. Are any of them dangerous to man?

A. Some of them are disliked on account of their uncouth appearance, but none of them are in any degree dangerous, and a few are useful.

CHAPTER II.

PHYSIOLOGY OF REPTILES.

Q. What is the meaning of the physiology of any class of animals?

A. An explanation of the way in which the living principle is modified in them as compared with other animals.

SECTION I.—MOTION AND ITS ORGANS.

Q. What are the organs of motion in reptiles?

A. They are bones and muscles the same as in quadrupeds. In the large ones the bones are firm as in quadrupeds; but in the smaller ones, as in the frog, they are cartilaginous or flexible.

Q. What are the general characters of the skeleton?

A. The skull is always very small; the jaws are often very large; the number of vertebræ, or divisions in the back-bone, varies very much; and the other parts of the skeleton vary with the habits of the species.

Q. What are the particular organs of motion in the tortoises?

A. The legs and feet, in the same manner as in quadrupeds; the head and tail also move; but the shell admits of very little motion in the back-bone and ribs. The sea-tortoises, or turtles, which find their food chiefly in the water, swim well, but can hardly be said to walk, but rather shuffle along like seals; while the land-tortoises walk with ease, though very slowly. The paws of the sea-turtles, although they consist of a number of bones, are united each in one general covering.

Q. What are the characters of the divided paws?

A. The number of toes of which they consist, varies from two to five; and the particular way in which they are armed, is, as in the case of the warm-blooded animals, adapted to the different functions it has to perform, such as walking, climbing, or seizing prey.

Q. What are the organs of motion among the saurians?

A. They resemble those of quadrupeds, only, in general, the legs are smaller in proportion to the body, and they are not so well set on them. In some the tail is prehensile, and assists the animal in climbing trees; and others can leap to a considerable distance.

Q. As the serpents have no feet, what are their means of motion?

A In serpents, the scales and ribs answer nearly the same purposes as feet do in other animals; and these, with the great power which they have of bending and stretching the back-bone, are their means of motion.

Q. How do these produce motion?

A. The scales are imbricated, or tiled over each other, with all the exposed edges turned towards the tail of the animal; and there is machinery connected with them, by means of which the edges may be raised or laid flat, or the scales brought nearer each other, or moved further asunder. The animal has also the power of raising its flexible body into one or more arches. Each arch is formed by the scales towards the fore part taking hold of the ground, in which those that are attached to the ribs are moved by these, as feet are by legs. The raising up to form the arch, draws forward the rest of the body. The scales at the hinder part of the arch are then elevated, and take hold of the ground, while the arch is flattened, by which means the fore part of the body is advanced; and the moving forces are so many, that the motion is constantly going on in some part of the animal, so that it has the appearance of gliding.

Q. Then the motions of the back-bone and the scales answer the same purposes as those of feet?

A. They do, and very effectual and active feet too. The back-bone twists in every direction, so that they can glide over unequal surfaces, climb trees, swim, and perform almost any sort of motion.

Q. Can they leap?

A. Many of them can: by shortening the body, laying hold with the scales near the tail, and suddenly stretching it, they are projected like an arrow.

Q. Have not some of the order peculiar contrivances on the feet, by means of which they can climb walls and rocks?

A. Yes; some of the lizards have suckers on their feet, by means of which they can run, not up walls merely, but with their backs undermost, in the same manner that flies do along the ceiling of a room.

Q. How does the sucker act?

A. Upon the very same principle that a stone can be lifted by pressing against it a moistened piece of leather, with a string fastened to the centre of it. The sucker is pressed air-tight, and then, as the leg pulls by the centre, just as the string pulls the centre of the leather, the pressure of the air keeps the sucker firm.

Q. And how is it detached?

A. The middle is pressed down by the animal, and the sides raised, by which means the air gets below it.

Q. Are those operations performed every time that the lizard or the fly lifts a foot?

A. They are; and they are done so rapidly, that they do not appear to occupy any time. The motions of some of these creatures are far more curious than those of the quadrupeds, more especially the serpents, which, though apparently destitute of feet, are, by means of their scales, made feet all over.

Q. Is there any thing peculiar in the ribs of serpents, which enable them to act as feet or legs?

A. There is. They are articulated to the back-bone by ball-and-socket joints, having more resemblance to the articulations of limbs than to those of the ribs of the mammalia; and the lower ends are fastened, each singly, to a scale, and not to a breast-bone.

Q. Is there any thing peculiar in the skeletons of frogs?

A. Yes, they are without ribs, and thus they can dilate their sides the whole length.

Q. Any thing peculiar in their motions?

A. They are bad walkers; but they jump—the motion best fitted for enabling them to catch flies and other insects.

SECTION II.—SENSES OF REPTILES.

Q. What particular part of the animal structure is the seat of sensation?

A. The brain, and its continuation in the spinal cord and the nerves.

Q. Are these abundant in reptiles?

A. They are much less so than in the warm-blooded animals. In some of them, as in the turtle, the brain is very small; in others, as the frog, it is much larger.

Q. Have they the five senses, the same as the warm-blooded animals?

A. So it is understood; but some of them are supposed to be much more acute than the others.

Q. What is the organ of taste?

A. A tongue, as in man and quadrupeds; but it varies very much. In turtles and crocodiles it is small and hardly moveable, while in some lizards it can be darted rapidly to a considerable extent beyond the mouth.

Q. What are the organs of smelling?

A. Nostrils, the same as in the mammalia; but these are so small and imperfect, that there is every reason to believe that they are nearly insensible to smell.

Q. What are the organs of hearing?

A. With the exception of the crocodiles, (and they have but merely rudiments,) there are no external ears among reptiles; but they have the internal organs, though varied in the different species. It is probable that, in some of them at least, the opening for hearing is that of the mouth, and that the sense is not very acute.

Q. Are their eyes perfect?

A. In general they are remarkably so. Sight appears to be the important sense with them; and many of them have peculiar contrivances for the eyes.

Q. What are the forms of the eyes?

A. The pupils or openings are in some, as in the crocodile, elongated vertically, as in the cat; in frogs, and in some lizards, it is four-cornered; and in tortoises, common lizards, and some others, it is round. In many reptiles the lens of the eyes resembles that of fishes in being nearly spherical.

Q. What are the additional apparatus in the eyes of reptiles?

A. Many of them have a third eyelid, as in birds, which can be brought rapidly over the eye, while the common eyelids are not moved; and many lizards have one eyelid that draws over the eye like a purse, or expands and contracts all round.

Section III.—Nourishment of Reptiles.

Q. Is there any difference between the mode of supplying nourishment in reptiles and in quadrupeds?

A. There is. No reptile has any cheek-teeth, or any other apparatus for chewing or masticating its food.

Q. What, then, are the different divisions in their nourishment.

A. Seizing their food, swallowing it, and digesting it.

Q. What are the means of seizing their food?

A. Jaws, which have frequently more varied and powerful motions than those of the mammalia, and which are sometimes armed with teeth, and sometimes not.

Q. What are the peculiarities of motion?

A. Both jaws are moveable. This is peculiarly the case with the crocodiles, in which the lower jaw has a motion, and the upper a motion on the under, so that the gape opens both ways, and approaches to a straight line, while the jaws close with twice the rapidity, and bite with twice the force that they would if only one of them moved.*

Q. Is there any thing peculiar in the mouth of the tortoises?

A. Their jaws are armed with horny mandibles, something after the manner of hoofs. These are in some species notched, so as to have some resemblance to teeth, though no tortoise has teeth.

Q. What motion have these?

A. Only the lower jaw moves. The mandibles close over each other, like a box; and the force with which they shut is so great that a turtle can tear asunder a thick rope. Its jaws once closed, cannot be opened; and the muscles continue in action for hours after the head is cut off.

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* M. Geoffrey, Annals du Museum, ii. p 39.

Q. Have all the saurians teeth?

A. They have all teeth in both jaws, and some also on the palate. Those teeth are pointed, and generally turned backward. They are adapted for holding, and those upon the palate also assist in the operation of swallowing.

Q. What are the characters of the mouths of the batracians?

A. The salamanders have teeth in both jaws; the frogs have none in the under jaw, and the toads have none in either; but they all have teeth on the palate. Their jaws also consist of a number of bones, and are adapted for closing with great rapidity.

Q. What means have the serpents for seizing their prey?

A. The larger ones watch in trees and other places, where they drop or spring upon their prey, and crush it in the folds or coils of their bodies. The smaller ones seize it with their teeth.

Q. How many kinds of teeth have they?

A. They have two kinds: common teeth, of which they have usually one row in the under jaw and two rows above, the innermost being on the palate. All these are pointed toward the throat. They have also poison-teeth or fangs, which are sometimes, though improperly, called stings.

Q. What are these like?

A, They are moveable teeth, placed one on each side of the upper jaw, and each has a tube or hollow in the middle, which opens near the point. This tube is connected with a bag that contains the poison; and when the animal bites, the fangs are erected, and the poison passes through the opening into the wound.

Q. If those teeth are destroyed without destroying the apparatus, would the serpent be capable of inflicting a poisonous bite afterwards?

A. That is not exactly known. Reptiles have the power of reproducing many parts of their bodies; and there are the rudiments of tubes or grooves in other teeth of poisonous serpents besides the fangs, but whether there be any means by which these could connect themselves with the poison has not been ascertained.

Q. What sort of substance is the poison?

A. It resembles gum, and retains its noxious qualities after it has been dried. The deadly nature of the poison depends upon the species of serpent, the state of vigour that it is in, the size and condition of the animal bitten, and the part into which the poison is introduced. If any considerable portion of the most virulent poison be inserted into a large blood-vessel, death very speedily ensues.

Q. Is there any thing peculiar in the swallowing power of reptiles?

A. The most remarkable one is the extent to which their throats expand?

Q. Which are the most remarkable in that respect?

A. The serpents, some of which can swallow an animal two or three times the usual thickness of themselves.

Q. How can they accomplish that?

A. By the particular way in which the bones of the jaws are united. There is a joint at the middle of the lower jaw, and it is connected with the bones of the head through the medium of other two bones. The connection of the upper jaw with the head is also loose, so that the whole circumference of the mouth, dilated at the joinings, can be brought nearly to one circular opening. The gullet is also constructed of a substance that admits of an almost unlimited quantity of stretching.

Q. Is there the same power of swallowing in the others?

A. No; but all the class have greater powers in that way, than animals which divide or masticate their food.

Q. What are the characters of the digestive powers of reptiles?

A. As they do not masticate, or in any way prepare the food in the mouth, the gastric juice, or digestive fluid in the stomach must be very powerful. The forms of the stomachs vary a good deal; but the intestines are in general short.

Q. Do they all live upon animal food?

A. The greater part do; but the land *chelonia* live, partly at least upon vegetables; and the sea ones, on turtles, and partly upon sea-weeds, which they browse by culling them with their horny jaws. The weeds on which they live are called "turtle-grass."

Q. Is the digestive process rapid?

A. In some instances it is not. Live animals that have been swallowed by reptiles, have been found not merely undissolved, but alive in their stomachs two or three days after being swallowed.

Q. Are they voracious?

A. Some of them are very voracious; but they have wonderful powers of living without food. Turtles and tortoises have been known to live from ten to eighteen months without eating any thing, even when not torpid. Toads have lived for years without any; and there have been instances of reptiles returning to vitality after having been for long periods inclosed in ice.

Q. Is there any other peculiarity in their abstinence than its length of time?

A. Yes. When they are without food there is a gradual diminution of their vitality. All their animal powers diminish; but there is no corresponding waste of substance. When a turtle is long kept in a fasting state, it approaches torpidity, but the consistency of the flesh is but little altered.

SECTION IV.—CIRCULATION OF REPTILES.

Q. Is there the same uniformity in the circulation of the reptiles as the mammalia?

A. No. In the chelonia, the sauria, and the ophidia, the heart is a sort of double, though the circulation is not so completely divided into two systems as in the warm-blooded animals, but in the batrachia, the heart is single and very simple.

Q. Are there any differences between the blood of reptiles, and that of the mammalia and birds, besides the former being cold and the latter warm?

A. Yes. The quantity of blood in reptiles is much less in proportion; and though there be differences in that respect in the different orders, the arterial blood differs much less from that in the veins. In consequence of the smaller quantity of blood, the muscles or fleshy fibres of reptiles are much whiter than those of the mammalia.

Q. What are the most remarkable consequences of the slower circulation?

A. Unquestionably the most remarkable are the reproduction of parts that have been wholly destroyed; and tenacity of life.

Q. Which are some of the instances in which members are reproduced?

A. In some of the lizards the tails are so slender and brittle that they break off on being handled; and in these cases a new tail, and in some instances two new tails, are speedily produced from the stump. In the common lizard of this country, or the water newt, if a limb is cut off, the wound first bleeds, for a few minutes; then the wound heals; then the rudiments of a new limb make their appearance; and the limb is perfected in a period varying from some months to more than a year. In an experiment by Blumenbach, in which the ball of the eye of a water newt had been extracted, leaving only the optic nerve and part of the membranes, the eyelids first closed, but in about a year an eye perfect in all its parts was reproduced.

Q. You mentioned another result of the peculiar circulation of reptiles?

A. Yes. Their tenacity of life under circumstances, such as changes of heat and cold, by which the warm-blooded animals would be destroyed.

Q. Is it true that any reptile, such as the salamander of the vulgar, can live in fire?

A. That certainly is not true, but lizards and alligators can live in hot springs, the temperature of which is much higher than that of the air in the very hottest countries, while frogs and newts after they have become torpid, can endure cold more severe than that which freezes water. Some reptiles too, have been found to live for hours in spirits of wine, and others in vessels wholly exhausted of air. Reptiles too have borne some very cruel experiments: they have lived after the brain has been taken out; and a turtle has moved its limbs thirteen days after the head has been cut off.

SECTION V.—BREATHING OF REPTILES.

Q. Then if reptiles have these powers of life so much stronger than the warm-blooded animals, do they breathe more in proportion?

A. No, they breathe less, and their lungs or organs of respiration are much more simple.

Q. How do they differ from those of the warm-blooded animals?

A. Instead of consisting of a vast number of cells as those do, they rather resemble bags divided into more or fewer parts by partitions according to the order. These are much complicated, or consist of the greatest number of parts in the tortoises, and are but ten in the frogs, but in all they are very simple, and the parts into which they are divided are much larger than those in the warm-blooded animals.

Q. Have they ever gills like fishes?

A. They never have gills like fishes; for they are not like them furnished with peculiar bones, flaps, and covers, which have proper motions, so that a current of water passes only one way through them. They hang loose on each side the neck, and though the water passes probably only one way through the fringes of the gills, it passes and repasses by the mouth, and they do not respire it by the same regular motions as fishes.

Q. Which of the reptiles have gills?

A. Young frogs have them while they are in the tadpole state, live entirely in the water, and have no feet; but as soon as the feet are formed the gills and the finny tails are absorbed; the lungs are produced, and the nature of the creature is changed from a breather of water to a breather of air.

Q. Have any other reptiles gills, but the batracians in their young or larvæ* state?

A. They have been found also in the Siren and the Proteus, two animals that will be mentioned in another place; but of which the natural history is a little obscure.

Q. How do those that have lungs breathe?

A. They take in air chiefly by the mouth in the act of swallowing, they take it in very large portions at a time, so that the operation is slow.

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* See Catechism of Entomology.

Q. Can they suspend their breathing?

A. Reptiles have very wonderful powers of suspending all their faculties without losing the ultimate use of them; and the suspension of one important function is always attended by the diminution if not the suspension of the rest. But when the breathing is suspended the blood may still circulate in part, as there are direct communications between the cavities of the heart, by means of which the blood can circulate without passing through the lungs, which is not the case in the warm-blooded animals.

Q. Are there any instances in which reptiles have lived for a considerable time without respiration?

A. Turtles have lived for a month with their mouths closely tied up, and their nostrils stopped with wax, so that they could not breathe; and there are well authenticated instances of live toads being found imbedded in the trunks of trees, and in blocks of stone, where they must have existed without breathing for many years.

Q. What changes do reptiles produce on the air which they breathe?

A. The very same in nature, though not in degree, as the warm-blooded animals: the oxygen of the air is consumed, and given out again, united with charcoal, in the form of carbonic acid.

Q. Then reptiles cannot live in air that does not contain oxygen?

A. They cannot live very long in such air: but they can do so much longer than the warm-blooded animals, because they can suspend their respiration.

Q. As reptiles thus evidently breathe for the same purpose as the warm-blooded animals, do they not, like them, generate, or produce heat?

A. They do; but in very trifling quantity. The body of a live frog is but very little warmer than the air, even on a moderately cold day.

Q. Have reptiles any voice?

A. It is probable that all animals that have lungs and breathe by the throat, have voice of some kind or other. Every body is familiar with the voice of frogs; serpents hiss; some of the saurians whistle; others, such as the crocodile, roar like thunder, turtles moan and sigh, and also hiss. Indeed there are, at most, only one or two species, that have not been heard to make some peculiar sound.

Q. What is to be inferred from that?

A. That though they have little internal appearance of ears, their sense of hearing is, perhaps, more acute than might be supposed.

SECTION VI.—COVERINGS OF REPTILES.

Q. Are there any peculiarities in the coverings of reptiles?

A. There are many. In some instances they are covered with skin, resembling that of other animals; in others they have scales; and in others, again, they have large plates, generally made up of smaller ones, to which the name of shell is given.

Q. Of what are the scales and crusts, or shells of reptiles composed?

A. Of a substance resembling horn, and not containing any salts of lime, like the shells properly s called, so that it is a very tough substance, and difficult to break.

Q. Which are most remarkable for this horny covering?

A. The chelonians, which all have two plates, more or less horny, and united to each other in the different species; the one covering the upper part, and called the *shield*, or *carapace*; the other, covering the lower part, called the *breast-plate*, or *plastron*; and answering the same purpose as the sternum or breastbone in the mammalia.

Q. Do these plates serve in place of skin?

A. No. The animals have a skin under them, and they themselves are covered by an *epidermis*, or cuticle.

Q. When the skin is not covered by shields of this description, has it any defence?

A. In the batracians, it is generally naked, and moist, or clammy; but in the saurians and the ophidians, there are generally scales, of different forms and sizes, and in different arrangements in the several species.

Q. Do they ever change their skins?

A. The chelonians do not; but the saurians and batracians sometimes do, more especially when they are young, and just after they have come out of their winter interments. They lose the old cuticle gradually, however.

Q. What is the case with the ophidians?

A. They cast their skins regularly, and the whole is renewed at once.

Q. Do they cast the entire skin?

A. They do not. The *corium, or* leathery part of the skin, is more intimately connected with the numerous muscles under it, than in any other animal; and as the moving forces of the animals (those muscles) are under the skin, and the instruments of motion or scales without it, the skin is never cast, it is only the cuticle or external membrane; and the necessity for its removal appears to be its becoming too dry and stiff for the numerous and rapid movements of the parts under it.

Q. Do the skins of reptiles secrete, or give out any offensive substances?

A. The crocodiles have apparatus on the lower jaw, which give out a substance that smells like musk. Some of the batracians, as salamanders and toads, when irritated, become covered with an acrid, but not a poisonous fluid; and some of the saurians, as the geckos, secrete a venomous liquor between the toes.

SECTION VII.—HYBERNATION OF REPTILES.

Q. You mentioned that reptiles became torpid during the cold?

A. They do. It was mentioned that, in them, the principle of life is much more passive than in the warm-blooded animals; and that they are, therefore, more under the influence of the common laws of matter. The heat, which fatigues and exhausts the warm-blooded animals, gives peculiar vigour and activity to reptiles; and as the heat diminishes by the approach of winter, they become inactive, and all their functions are nearly suspended, which state of repose is called hybernation or wintering.

Q In what places do they take up their winter quarters?

A. Turtles and water tortoises bury themselves in the sand and mud at the bottom of water; land ones dig down into the earth, and cover themselves to a greater or less depth; crocodiles hide themselves in the sand banks; other saurians bury themselves in natural holes, or holes made by themselves; while the batracians creep into all sorts of caverns and crannies, about rocks, walls, and other places of shelter, and some of them burrow in the walls, and under and near the hearths of mud-cottages, and other places where they can enjoy artificial heat.

Q. Do these hybernations proceed entirely from cold?

A. It does not appear that they do altogether; for it takes place even in the warmest climates, where the temperature is always warm, and land-tortoises have been found to hybernate for some weeks, even when kept in rooms where constant fires were burning. When they are exposed to warmth, the period of hybernation is not so long, however, as when they are exposed to cold.

Q. What are the appearances that precede the hybernation?

A. The circulation and breathing of the animals are suspended, they cease to eat, and become colder than when they are in a state of activity.

Q. What state are they in during the hybernation?

A. It must be considered as a state of profound sleep, but it is a sleep that is death-like, as they are utterly insensible, and cannot be roused from it by any treatment. They may be cut, torn, or even broken in pieces, without making the least motion, or giving the slightest evidence that they are pained by the treatment, or have any feeling whatever of it.

Q. Does it differ from the hybernation of bears, marmots, and other mammalia that are subject to periods of torpor?

A. It does. During the hybernation of the mammalia, there is a waste of substance—a decay of the fat which they acquire previous to passing into the torpid state, and also a waste and softening of the muscles; but in reptiles there seems a total suspension of action, both involuntary and voluntary, and when they return again to the living world, they are very little diminished in weight.

SECTION VIII.—REPRODUCTION OF REPTILES.

Q. Are all the species of reptiles in two sexes, male and female?

A. So far as observation has gone, they are.

Q. How are the young produced?

A. They are all produced from eggs, and therefore they all belong to what may be called *oviparous*, or egg-producing animals; but some of them hatch their eggs internally, and the young are brought forth alive, and then are called *oviviparous*, or live-egg producing.

Q. How are these eggs hatched?

A. In general by the heat of the atmosphere, assisted by that of the sand or other substance in which they are buried by the parent. The eggs of frogs bear a considerable resemblance to the spawn of fishes, and are deposited in the water, in which the young ones are to live, during the first period of their existence. Those eggs can bear to be frozen without having their vitality destroyed.

Q. Are the eggs of all the batracians of this description?

A. No. Those of the salamanders are brought forth entire, but all the batracians pass through several forms of existence, between the egg and the perfect, or mature animal.

Q. Are the eggs generally in masses, like those of frogs?

A. No; that is the case only with frogs and toads. The eggs of the others are detached, generally round, covered with a shell of salts of lime, like the eggs of birds, or with a membrane not unlike that which lines the shell of a pullet's egg, but generally of a firmer texture. The internal parts of the more perfect eggs, are not unlike those in the eggs of birds, but the *albumen* or *white*, does not coagulate or become firm by heat.

Q. Are the eggs eatable?

A. Those of the chelonians are, even in those species where the flesh of the animal occasions diseases: and it is reported that those of the crocodile are equally wholesome.

CHAPTER III.

Chelonian Reptiles.

Q. You mentioned already, that the chief distinction of this order is the shell, from which the head, tail, and limbs project, and the absence of teeth, the place of which is supplied by horny jaws. Have you any further observations to make?

A. The form of the pieces of which the shield or back-plate is composed, their texture, and the manner in which they are joined, are all external characters, by which the different species are distinguished.

Q. What are the different parts of the shield?

A. They are the *disc*, or middle, which generally consists of thirteen plates or pieces, and the vertebral plates at the sides, which vary from twenty-one to twenty-five.

Q. What are the particulars in the form of the plates?

A. If the individual plates be raised in the middle, they are said to be *carinated*, or keeled; if they be the reverse, or hollowed in the middle, they are said to be *furrowed;* if their edges lie upon each other, as those of the tiles do on the roof of a house, they are said to be *imbricated*, and if they be toothed at the edges, they are called *cerrated.* If the breast-plate has a sort of joint in the middle, and can shut against both ends of the shield, the animal being wholly within, they are called *box-tortoises;* and if the shell, or part of it, be flexible, like leather *(corium)*, they are called *coriaceous*, or soft.

Q. What are the divisions of the chelonians?

A. They are divided into two genera, *Chelonia*, or *turtles*, and *Testudo* or *tortoises*.

I.—TURTLES.

Q. What are the characters of the turtles?

A. They have the feet flattened like oars, the toes united, and flat nails in the margin; they are the largest of the order—some of them weigh 700 or 800 pounds; they all inhabit the sea, and feed upon sea-weeds and the small animals that are found among them; they come on shore to deposit their eggs, but they walk very slowly and with difficulty.

Q. How many species of turtles are there?

A. There are at least six, that have been ascertained, and there are probably one or two more, though different describers have given different names to the same species; the species are—

1. *C. Mydas*, the green turtle.

2. *C. Rugosa*, the furrowed or wrinkled turtle, which have the body of the shield chestnut, and the edges yellow, and each plate marked with three transverse black furrows.

3. *C. Caretta*, the hawks-bill turtle.

4. *C. Cepediana*, the cepedian turtle, which has the feet very thin and only one nail on each.

5. *C. Caouauna*, the Mediterranean or logger-head turtle.

6. *C. Coriacea*, the leather-coated turtle.

Q. Of what seas are these inhabitants?

A. Of the tropical seas generally, but the Caouauna is often found in the Mediterranean, and sometimes in the seas farther to the north.

Q. Is there any particular quality for which the green turtle is recommended?

A. Yes, it is the one the flesh and fat of which are are so much esteemed as articles of luxury in Europe, and which are so valuable as articles of common food in the tropical parts of all the oceans—the Atlantic, the Indian, and the Pacific.

Q. Can you describe it?

A. A full grown green turtle is about six or seven feet long, from the nose to the tail, from three to four feet in breadth, and nearly the same in thickness at the middle part of the body. The body is of an oval figure. There are thirty plates in the shields, which are neither carinated nor imbricated: they are thin and united by cartilage. The centre of the back is rather flat, so that when laid on its back on land, the animal cannot turn itself; the head is rather large, the tail short and thick, the feet long and furnished with two claws upon each, but they are better fitted for swimming than for motion upon land.* One of the size mentioned, will weigh altogether about 800 pounds.

Q. Why is it called the *green* turtle—is that its colour?

A. No, the colour, when healthy and in the water, is a bright brown with yellow spots, though it deepens as it dries.. It is called the green turtle from the colour of the fat.

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* The head, neck, feet, and tail, are covered with scales.

Q. What are its localities and its habits?

A. It is found in great abundance on the shores, and in the mouths of the great rivers, in the East and West Indies, and on the shores especially of the northern part of New Scotland. It swims very rapidly with the head and part of the shell above water, but can dive to the bottom when danger threatens it; though as it is very nearly the same weight as water it goes rather slowly to the bottom. It sometimes leaves the water and goes into the moist and shady woods in unfrequented places.

Q. On what does it feed?

A. Upon different species of sea-weed, and also upon the mollusca and insects that are abundant in the tropical seas. The latter it swallows entire, but it bites off the former with its horny jaws.

Q. Is it a solitary or a social animal?

A. It is not, strictly speaking, either one or the other. Reptiles have few of those attachments which we find among the warmer blooded animals; and though turtles are generally found in numbers at the same place, they do not appear to heed each other very much, if at all.

Q. Is there any time when turtles frequent the shores?

A. Yes, they come to the shore in numbers to deposit their eggs in the sand; the time of their doing that varies with the latitude, but the average time is about the month of April.

Q. Do they always deposit their eggs on land?

A. Invariably, and in places where they can find dry sand to cover them; but they are never far from the high-water mark.

Q. What sort of nest does the turtle form for her young?

A. She scrapes a hole in the sand about two feet in depth, into which she deposits about one hundred eggs, and then covers them with sand.

Q. Does one female lay as many as one hundred eggs in one season?

A. She lays several hundreds, but there are only about one hundred in one hatch. The hatches are laid by the same female at the distance of about two weeks, so that the laying season lasts for about two months, and after it is over the turtles retire, first to the deep water and then to their winter quarters.

Q. How long do the eggs require to hatch?

A. About three weeks, when the weather is moderately warm.

Q. What are the young like when they first make their appearance?

A. They have the shape of turtles, but a soft covering instead of a shell.

Q. What do they eat at first?

A. Some of the soft productions of the sea; for they make directly for the water, the instant that they are out of the shell.

Q. Then as the number of eggs laid by a single female is so great, the green turtle must be very numerous?

A. There are considerable numbers of them, but it is part of the economy of nature, that where any thing, either animal or vegetable, is produced in great abundance, the means of destroying keep pace with it.

Q. What are the particular means of destruction in the case of the young turtle?

A. Their greatest destroyers are cormorants and other large birds, which watch the beaches during the whole season from May till September. These destroy a very great number of young turtles, and the alligators and other predatory inhabitants of the waters, destroy a good many more.

Q. Does man capture many?

A. Not in that young state. The eggs, which are round, about the size of a billiard ball and covered with a skin like parchment, are very much sought after, as when they are new they have a good deal of the musky flavour of turtle in high condition, and are particularly wholesome and nutritious.

Q. Are the large ones often captured?

A. Yes, the places which they frequent, are resorted to as regular fishing-grounds; and there are two modes of catching them, on the shore and in the water.

Q. What is the usual mode on shore?

A. The usual way is to turn them on their backs, which often requires the assistance of several men; when so turned they cannot escape; and thus when as many as are wanted or can be procured, are turned, ropes are fastened to them and they are dragged away, their own shields serving as sledges.

Q. And the quantity thus found is considerable?

A. It is; the flesh of turtles is sold cheaper in most of the West India markets, than that of land animals.

Q. What is the mode of capturing them in the water?

A. The usual mode is what is called "pegging," and it is worthy of remark, that it is practised nearly in the same manner by civilized nations and by savages, the chief difference being that the former use iron weapons and the latter not.

Q. What is the form of the weapon?

A. A spike or peg, barbed, that it may retain its hold, is fastened loosely to a pole; and either the pole or some other piece of light wood, is fastened to the peg by a string or otherwise. The peg is struck into the turtle, and disengages from the pole; but the float remains and at once impedes the progress of the turtle and prevents it from sinking.

Q. Is any part of the green turtle of value, except the flesh?

A. No, the shell is of little use; though Ælian mentions that the nations of the east, in former times, made canoes of the shields of turtles.

Q. Was turtle known in ancient times?

A. Yes, turtle as an article of luxury for the tables of the great, is mentioned as part of the ancient commerce of India.

Q. Is any other species of turtle of importance, as an article of commerce?

A. Yes, the hawksbill turtle is even more largely an article of commerce than the green turtle. The plates of the shields of it, form the well-known and beautiful substance—"tortoise-shell."

Q. What are the characters of that species?

A. It is smaller than the green turtle, more elongated, the head smaller, the upper mandible projecting forward over the other, and covered, so that the snout and gape have altogether some resemblance to the beak of a hawk, whence the common English name. The feet, especially the fore ones, are larger than in the green turtle: and it is altogether a more active and formidable animal. It defends itself when attacked, and bites with great force.

Q. Is it captured in the same manner as the other?

A. No, it cannot be made sure of by turning, because the greater roundness of the back, length of the legs, and its activity, enables it to recover its position; and its proneness to bite is such, that it is not quite safe to go near it while alive.

Q. What is the weight of the hawksbill turtle?

A. Very seldom more than 300 pounds, and not often so much.

Q. What is the form of the shield?

A. It is a little heart-shaped, being rather pointed behind, and having a sort of notch at the neck. The disc or valuable part consists of thirteen plates, which are imbricated, curvated, and partially carinated; they are of firm texture, beautifully clouded, take a fine polish, and do not warp with heat, or split as readily as bone.

Q. What quantity of shell may be in one specimen?

A. Six or eight pounds is an average quantity.

Q. And the animal is killed for that?

A. In general it is; but the Malays of the islands in the Indian seas, who have long been tortoise-shell merchants, are said to have a method of detaching the plates from the animal while alive, and returning it again into the sea, where they are speedily reproduced.

Q. Of what seas is it a native?

A. Of the same seas as the green turtle; indeed, it is more widely diffused and more plentiful. Hawksbill turtle are got in great numbers near the British settlement of Belise in Honduras; but the most beautifully coloured is said to come from the Indian Seas.

Q. Has tortoise-shell been long used?

A. The Romans had it from the east in large quantities, and it was known there long before their time.

Q. Is the shell-turtle used for food?

A. The eggs are very good, as indeed those of all the turtles are, but the flesh is rank-tasted and not wholesome.

Q. What are the peculiarities of the loggerhead turtle?

A. It is a large animal, larger even than the green; the head is large, the mandibles hard and strong, the bite very powerful, and the disposition very fierce.

Q. Of what seas is it a native?

A. Its range is wider than that of any of the other turtles, as it is by no means unfrequent in the Mediterranean, especially on the coasts of Sicily and Sardinia. It is more abundant however in the tropical seas, and has been met with sleeping on the surface in the middle of the Atlantic.

Q. On what does it feed?

A. It feeds a good deal upon shell-fish, the shells of which it can easily break with its mandibles, and it also feeds upon young crocodiles.

Q. Has it a strong shell?

A. It is tough and not easily torn, but too thin for being of much use in the arts, although it has sometimes been used in cabinet work.

Q. Is the flesh eatable?

A. It has not the same tendency to produce disease as that of the hawksbill turtle, but it is harsh and disagreeable, and eaten only by the poorer classes of the people. When in good condition it affords a considerable quantity of oil.

2. Tortoises.

Q. Are the tortoises more numerous than the turtles?

A. They are; and they vary much more in their sizes, their localities, and their habits.

Q. What are the general characters of the tortoises?

A. The tortoises are in general much smaller; they are better walkers, and they have a claw upon each toe, whether the toes be enveloped in one covering or separate.

Q. How many species are there?

A. There are upwards of fifty.

Q. Do they inhabit the land or the water?

A They can exist in either, but the greater number live chiefly in the water. There are about thirty-four water species, and half the number of land ones.

Q. Do the water tortoises inhabit the sea?

A. No; they are inhabitants of fresh water.

Q. Have they all horny shells?

A. The majority have, but there are some that have leathery coverings resembling those of the coriaceous turtle?

Q. How then are they distinguished from that?

A. The tortoises are not found in the sea; they are smaller than the coriaceous turtle, and they have sharp claws, while the feet of that are formed like fins. The body of the coriaceous turtle is covered with a shell, over which it has the leathery envelope: that of the tortoise has the shield hard in the middle and soft and pliable like leather towards the sides.

Q. Which tortoise is it that has a covering resembling that of the leathery turtle?

A. The fierce tortoise, *testudino ferox*, which gets its name from the boldness with which it seizes its prey.

Q. Where is it found?

A. Only in America, and there chiefly in the rivers and fresh water lakes of Carolina and Florida, where it lurks in the mud or among the aquatic plants. It catches its prey, which consists of young aligators and small animals, by darting out its long neck with great rapidity, and when it is assailed, it rises on its hind feet and darts forward, and if it takes hold, it does not quit till after the head is cut off.

Q. Is it of any use?

A. Yes; its flesh is not inferior either in flavour or wholesomeness to that of the green turtle.

Q. Does it grow to any considerable size?

A. Not nearly to the same size as the turtles. It is seldom, if ever, found weighing more than seventy pounds.

Q Are any fresh-water tortoises natives of Europe?

A. There are at least two, the yellow tortoise, *testudo flava*, and the mud tortoise, *testudo lutaria*.

Q. What is the appearance of the yellow tortoise?

A. It is rather small, often not exceeding eight inches in length. It is oval, rather flattened, and of a brown colour, with yellow dots and lines radiated on each plate of the shield.

Q. In what parts of Europe is it found?

A. Chiefly in the eastern parts of the continent, from the shores of the Mediterranean to those of the Baltic. In France it is very rare, and it is not found at all in Britain. It lives in water that is muddy, and feeds upon insects, larvæ, and fishes.

Q. It it used for food?

A. It is sometimes met with in the German markets, and the eggs, which are about the size of those of a pigeon, may be eaten.

Q. What are the characters of the mud tortoise?

A. It is smaller than the yellow tortoise, of a blackish brown colour, the tail is half the length of the shield, and as the animal carries it straight out when it walks, the ancients sometimes called it the water rat.

Q. In which parts of Europe is it most abundant?

A. In the southern parts, where it is very plentiful in muddy waters. It feeds on worms, snails, and fish, and is often very destructive in fish-ponds, not only for what it actually kills, but for what it bites and mangles.

Q. Does it ever visit the land?

A. Very seldom, except for the purpose of depositing its eggs, though it can walk much better on land than some others of the genus.

Q. Could the mud tortoise be made of any use?

A. It might keep gardens clear of snails and other vermin, as it may be tamed, or at any rate familiarized without much difficulty; but it could not be kept in any place in which there was not a pond of water.

Q. Is there any thing peculiar in the young of the mud tortoise?

A. When they first appear they are very small, not exceeding an inch in dimensions, and they have three prominent ridges on the back, which are obliterated when they come to maturity.

Q. Are any of the land tortoises natives of Europe?

A. Yes; *testudina Græca*, the Greek tortoise, or common land tortoise.

Q. Is it a large species?

A. No. It seldom exceeds ten inches in length. It is oval; the shield is very convex, and it is broader behind than before. It is a native of the warmer parts of Europe, and also of more torrid climates; but it hybernates both in its warmer localities and in its colder; it begins its annual sepulture in October, and digs its winter habitation to the depth of about two feet. In doing so its motions are very slow, but they are very incessant; and after it has gone to some depth the earth is thrown upon its back, so that it sinks the better part in absolute concealment. It makes its appearance again in April.

Q. What are its favourite haunts?

A. Dry places, but shady, such as woods.

Q When are the young produced.

A. The eggs are deposited in the ground, about the end of June; they seldom exceed four or five; and the young make their appearance in September, at which time they are not larger than walnut-shells.

CHAPTER. IV.

SAURIAN REPTILES.

Q. ARE the saurian reptiles very numerous?

A. They are very numerous, and they differ more in their sizes, appearances, and habits, than any other order of living creatures.

Q What are their common characters?

A. They have the same heart, circulation, and breathing as the chelonians; they have generally four feet; their jaws are armed with seizing teeth, their toes generally have claws; they have tails more or less elongated: they are covered with horny scales, though sometimes these are so small that they resemble mere points. They all lay eggs, and the young, when they come out of the eggs, have the same form that they are to retain for life. Generally speaking, they are more rapid in their motions than the chelonia, and they are understood to be shorter lived.

Q. Of what parts of the world are they natives?

A. The greater number are found only in the warm countries, but there are a few small species that are met with in cold, or at least, in temperate regions.

Q. Do they inhabit the land or the water?

A. Some inhabit waters, generally fresh water, others are met with only in dry and sunny places, and some again live mostly in trees.

Q. Into how many genera are they divided?

A. Into about sixteen genera, but these contain very many species, and some of them may be divided into sub-genera.

Q. Which is the first genus?

A. That which includes the most formidable animals, is the genus CROCODILUS, which contains all the animals to which the name of crocodile is given in common language.

Q. What are the generic characters?

A. The head is very broad and flat, the gape wide, and the teeth formidable, but the tongue is small, and adheres to the under jaw; the back and belly are covered with large horny plates, the tail is much compressed, or flattened, and armed on the upper part with two rows of scales, which stand up like the teeth of saws, but gradually approach each other, so as to form only one at the tip of the tail. They all have four strong feet, of which the hinder ones are more or less webbed, and have claws only upon three of the toes. They live chiefly in the water, but they can also live and walk readily upon land. The stiff articulation of the back-bone, especially the neck part, renders it difficult for them to turn.

Q. What are their dimensions?

A. These vary with the species, and yet more with the age of the individuals. The length is from four or five inches in the young, to as much as thirty feet in the old.

Q. How are they produced?

A. From eggs that have hard shells, and are about the size of those of a goose. The female crocodiles do not, as is the case with many of the reptiles, wholly abandon their young: they watch, at least partially, the places where the eggs are during the hatching, and also tend the young ones for a little time after they have taken to the water.

Q. What are the sub-divisions, or sub-genera of crocodiles?

A. They are *crocodiles*, properly so called; *gavials*, or long-muzzled crocodiles, and *caimans*, or blunt-nosed.

Q. What are the characters of the crocodile properly so called?

A. The muzzle is long and flat, one tooth on each side of the under jaw locks into a groove in the upper one, so that when it once seizes hold, it does not quit; there are six keeled plates on the neck, and the animal is more voracious and more indiscriminate in its feeding, than any other of the genus. The eggs are larger than those of any of the others, and probably the animal itself grows to a larger size.

Q. Where is it found?

A. In the Nile, and the other great rivers of Africa, and probably also in India, but there are varieties, if not different species. It lies in wait for animals when they come to drink, drags them under the water, and drowns them, but is understood not to eat them till they have began to putrify.

Q. Are all the stories that are told about crocodiles worthy of belief?

A. The crocodile is a very formidable creature, certainly, but there are fables told of all the more powerful and voracious animals.

Q. In what do the gavials differ from the crocodiles?

A. The chief difference is in the muzzle, which is longer, more slender, and nearly cylindrical.

Q. Where is the gavial found?

A. The best known species is found in the large and muddy rivers of India, chiefly in the Ganges. It feeds chiefly upon fish, and is not so dangerous to land animals, or to man, as the crocodile. There is some confusion about the sub-genera of crocodiles, as that which is called a crocodile by one naturalist, is called a gavial, or a caiman, by others.

Q. What are the characters of the caimans?

A. The caimans, which are also called alligators, have the snout broad and flat, and the fourth tooth on each side of the lower jaw, fits into a hole or cavity in the upper; the carinated plates on the neck are more numerous, but smaller, and the eggs also are much smaller.

Q. Of what countries is the caiman a native?

A. Chiefly of the rivers in the warm parts of America?

Q. What is the second genus?

A. *Dracena*, the dragon, of which there is only one species, a land animal, found only in South America, and there chiefly in Guiana. The body has something of the shape of the crocodile, but it is much more flexible, and the length never exceeds six feet; the toes are long, detached from each other, and have claws equally well adapted for climbing and burrowing. The flesh of the dragon is eaten.

Q. Has the dragon any of those formidable qualities of which we read in books?

A. It has not any of them; but is rather a timid animal.

Q. On what does it feed?

A. On the insects which are abundant on the banks of the rivers and sides of the marshes in South America.

Q. Which is its most formidable enemy?

A. The caiman, the animal that it most nearly resembles in form.

Q. By what means does it escape from that formidable enemy?

A By climbing the nearest tree.

Q. Is there any thing peculiar about the teeth of the dragon?

A. They are rather peculiar for the class to which it belongs; the back teeth having some resemblance to the grinding teeth of quadrupeds.

Q. What is the third genus?

A. *Basiliscus*, the basilisk, which is a very harmless creature, a native of the woods both of Asia and America. A curious wing-like ridge upon the back and tail enables it to leap to a considerable distance from branch to branch. In this it is probably assisted by the inflation of the throat, and the erection of a crest upon the head.

Q. Then the basilisk of naturalists is not the basilisk of the poets, which is represented as being so terrible?

A. Certainly not. The poets of antiquity are very unsafe guides in matters of natural history.

Q. What is the fourth genus?

A. *Tupinambis*, tupinambes, which are very active creatures, found in various parts of the world. They are long and slender. Some live on land, others occasionally in the water. They live upon small animals, and sometimes fruits, and destroy a number of the eggs of crocodiles and caimans.

Q. Of what particular countries are the tupinambes natives?

A. They are abundant in South America, in Egypt, and in the East Indies.

Q. Do they help to lessen the numbers of any more formidable reptiles?

A. They destroy the eggs of the crocodiles, gavials, and caimans, and are in turn preyed upon by even the young of these animals.

Q. What appears to be the use of the great numbers of saurian reptiles in the warm climates?

A. To destroy the great numbers of insects with which those countries abound, as those in turn do those putrid substances that would otherwise poison the air.

Q Is there any regular progress in this destruction?

A. There is; the insect is devoured by the small reptile, and the large reptile takes the small one into the water and devours it there, so that the putrid substance is wholly removed from the land.

Q. What is the fifth genus?

A. *Iguana*, guanas. These are, after the crocodiles and dragons, the largest of the saurians. Their form is far from handsome. Along the back, and great part of the tail, there is a ridge of prominent scales, which turn backwards, like teeth, and the same under the throat, which the animal can swell out to a very great size. The form of the legs is very clumsy, and the toes are of great length. The scales with which the body is covered are very smooth, and have a fine play of colours, the prevailing one being a warm brownish green. Its bite is very sharp, but it is a very harmless, and even valuable animal. It can be easily domesticated, and its flesh is esteemed a great luxury, and in some parts of tropical America, it is a staple article of food.

Q. How many species are there?

A. There are three, and they are found in the eastern continent, as well as in the western. Their principal food is insects.

Q. What is the sixth genus?

A. *Draco*, the flying dragon, of which there are three species; one beautifully marked with blue, grey, and white; another green, and a third brown.

Q. Have they any of the formidable characters of the dragons of which we read?

A. None whatever. They are very harmless, and in colour, at least, beautiful little creatures, seldom more than eight inches long, that can stretch a membrane like a fan on each side of their body, and thus project themselves to the distance of from twenty to thirty yards. They are found in all the warm parts of the world, especially in the Asiatic isles. They live upon insects, and their other habits very much resemble those of the flying squirrels.

Q. But are not formidable dragons sometimes exhibited?

A. Yes, but they are always dead. Impostors often manufacture dragons, in the same way as they manufacture mermaids, by uniting parts of different animals.

Q. What is the seventh genus?

A. *Agama*, agamas, of which there are at least twenty-five species. They are of various forms and colours, and found in all the hot countries. They are generally covered with small four-cornered scales. Some of them have the tails prehensile.

Q. Are the agamas numerous?

A. They are, twenty-five distinct species are known, and there are five distinct sub-divisions.

Q. What are these?

A. They are agamas proper, lizard agamas, prehensile agamas, flat-tailed agamas, and orbicular agamas.

Q. What are the characters of the agamas proper?

A. They have the tails cylindrical, and the power of swelling their throats to a very great extent. Their prevailing colours are green, blue, and red; they are more slender in the body than the others, and they are without tubercles.

Q. What are the characters of the lizard agamas?

A. They have plates on the head, and pores under the thighs. Only one species is known, a native of Surinam, beautifully marbled of a variety of colours.

Q What are the characters of the prehensile agamas?

A. The most remarkable one is, the power of laying hold with their tails. There is but one species, and in it the tail is not nearly so long as some of the tails that are not capable of laying hold.

Q. How does a prehensile tail lay hold?

A. It coils round like the tendril of a pea or a grape-vine, only the animal can coil and uncoil it at pleasure.

Q. What is the character of the flat-tailed agamas?

A. The flat tail is their only peculiar character. Some of them are jet black.

Q. What is the character of the orbicular ones?

A. They have the body roundish and flat, and spotted with tubercles.

Q. What is the eighth genus?

A. *Stellio*, stellios, of which there are several species, found only in the very hottest parts of Africa and America. They have some resemblance to toads. During the day they hide themselves in the chinks of old buildings, and under stones. They feed upon insects.

Q. What is the ninth genus?

A. It is a very singular one, *Chameleo*, the cameleon.

Q. What is there singular in the cameleon?

A. Its form is singular; it can look two ways at once; the insects upon which it feeds are so minute, and the motion of its tongue in drawing them into its mouth is so rapid, that it has been supposed to live upon air.

Q. Is there not also something singular in its colours?

A. Yes: its colours change, but that is not wholly confined to the cameleon, though more conspicuous in it than in any other animal. In all the saurians that have the power of dilating the skin of the belly very much when they breathe, that changes their colour.

Q. What are the colours of the cameleon?

A. Various shades of green and yellow, which vary from a tint that seems nearly blue or black, to one which appears almost, but never altogether white.

Q. By what substances are the changing colours of the cameleons produced?

A. The common way of explaining it, is from the colour of the blood, the colour of the skin, and the alternate thickening and thinning of the latter.

Q. What are the colours?

A. The colour of the blood is violet blue, and that of the skin bright yellow, but so thin and approaching to transparency, that the colour of the blood is seen through it, and combining with the yellow of the skin forms a green, which is the deeper the more the skin is stretched, and fades into yellow, whitish, and even brown, when the skin shrinks.

Q. Then is the colour deepest when the animal is most vigorous?

A. Of course it is; for when the animal is languid and the blood drawn inward from the surface, nothing is seen but the yellow skin, to which the parts beneath give a whitish or brownish tint.

Q. But does not the cameleon become of the same colour as the object on which it is laid?

A. As the natural colour is continually shifting from shade to shade, of green and yellow, as it breathes and its blood circulates, some shade of it has a very great chance of resembling that of any green or yellow substance on which the creature may be placed; but nothing could change it to white or scarlet.

Q. Where are cameleons found?

A. Principally in Africa. They are small and feeble creatures, the body of the largest is not more than a foot long, and the tail, which is prehensile, about as much.

Q. What is the tenth genus?

A. *Gecko*, geckos. There are a good many species of geckos, and they are found in colder latitudes than most of the order, some of them being found in the south of Europe.

Q. What is the appearance of the geckos?

A. They are not so unhandsome in their appearance as some of the others, but they are offensive in their habits.

Q. Is there any thing peculiar in their feet?

A. They frequent houses, and by means of the suckers upon their feet, they can run with their backs undermost.

Q. Is there any thing offensive about them?

A. An acrid liquor is secreted from their feet, which injures any substance over which they may pass, and stings the skin like nettles.

Q. What is the eleventh genus?

A. *Anolis*, anoles, which are found in the dry and warm parts of America. In their general appearance they resemble the geckos, but their feet are not constructed in the same manner. They are small, but active, and the males often fight with great boldness.

Q. What is the twelfth genus?

A. *Lacerta*, lizards; which are the most numerous, the most handsome in their forms, and the most widely diffused of the order. The upper part of the body is covered with small round, or six-sided scales, the under with small square plates, the tongue is forked and projectile, the tail is quite cylindrical, and has no crest on the upper side, and all the feet have five toes, armed with small crooked claws.

Q. What are their habits?

A. They are all perfectly innocent and lively. Their food is insects, and also vegetable substances; some live in ponds and marshes, some in woods, among grass, and others about houses.

Q. Are they subdivided into many sections?

A. There are seven sub genera.

1. American lizards, which have no collar of scales about the neck. Their prevailing colours are black, blue, and white.
2. Green lizards, which have a scaly collar, and are mostly green.
3. Ribbon lizards, which have longitudinal white lines on the body.
4. Spotted, 5. grey, 6, dragon lizards, and 7 striated lizards, which have scaly folds in the neck.

Q. Are the American lizards numerous?

A. There are six species.

Q. How many are there of the green lizards?

A. There are eight species: they are found in many parts of the world.

Q. How many are there of the ribbon lizards?

A. Seven species.

Q. And of the spotted?

A. Two species; the one found in the south of France, and the other in Spain.

Q. How many are there of the grey?

A. Seven species.

Q. What is the distinguishing character of the dragon lizards?

A. They have scaly folds on the neck. There are three species of them.

Q. Are there many of the striated?

A. There is only one species, it is grey and brown, with the scales on the back keeled.

Q. Which is the thirteenth genus?

A. *Tachydromus*, swift runners. They have the body, the tail, and especially the neck, much more slender in proportion to the length than the lizards. They are found in dry places, and run very fast.

Q. Which is the fourteenth genus?

A. *Scincus*, scinks, of which there are many species, natives of the hot countries, where they lie in numbers, basking in the sun. The ruins and rocks in the eastern desarts are quite covered by them, and when disturbed, they bury themselves in the sand in an instant.

Q. What is the fifteenth genus?

A. *Chalcides*, which differ from the efts chiefly in the arrangement of their scales, which are placed in rings, and not imbricated like the scales of the efts.

BRITISH SAURIA.

Q. Are there many reptiles of this order natives of Britain?

A. Only one species has been perfectly ascertained, the nimble lizard *(Lacerta agilis)*; it grows to the length of about six inches, has the tongue forked, and teeth in both jaws and palate. There are black bands on the back, and the tail has sharp scales formed into rings; the tail is brittle, but grows again if broken off. The skin is often cast, and as the colours vary with the age of the skin, that may be one reason why the animal has been described as a different species. It is found only in warm sandy places; it hybernates, and generally lays eggs, though sometimes the young are brought forth alive. It feeds upon live insects and worms, is a perfectly harmless creature, and may be tamed.

The naturalists mention some of the British lizards, especially the green one, but the statements have not been verified by very recent observations.

CHAPTER V.

OPHIDIAN REPTILES.

Q. What is the most general character of this order?

A. Being without feet, or having mere rudiments of them under the cuticle, hardly developed, and quite unfit for walking.

Q. Are they very numerous?

A. In the warmer parts of the world, they are, and some of them are very formidable from their size and strength, and others from their venom or poison.

Q. What is the most general division of serpents?

A. Into those which have the scales of the back and belly similar, and those that have them different.

Q. What further division is there of them that have the scales similar above and below?

A. Those which have a third eyelid, and those which have not; and they farther make about seven distinct genera.

Q. Are there any further differences among those that have a third eyelid?

A. There are. Some of them have partially the skeleton of quadrupeds, and others have not.

Q. What portion of that skeleton have they?

A. They have rudiments of shoulder-bones, collar-bones, breast-bones, and haunch bones.

Q. How many genera have these characters?

A. Two: *ophisaurus*, the lizard-snake; and *anguis*, the snake.

Q. What are the characters of the ophisaurus?

A. The tail is longer than the body; there are teeth in the jaws and also in the palate; and the animal is so brittle, that it is cometimes called the glass-snake.

Q. Is it venomous?

A. No snake that has the scales on the back and belly the same, is venomous.

Q. In what country is it found?

A. In the southern provinces of North America. It is of a greenish brown, marked with black on the back, and is quite inoffensive.

Q. What are the characters of the genus anguis?

A. They are without teeth on the palate, and are quite harmless. They live in holes near woods, and among rubbish, and subsist upon mice, frogs, and beetles. The most common is the blind-worm, *anguis fragilis*, which, like the former, is brittle.

Q. Is there any species with a third eyelid, which is destitute of the resemblance in the skeleton to that of quadrupeds?

A. There is an Indian genus, *acoutas*, the skin of one species of which is mottled like that of a Guinea-fowl. It is sometimes called the javelin-snake. It is quite harmless.

Q. What are the genera that have the scales the same on the back and belly, but want the third eyelid?

A. There are reckoned four of them, three of which are covered with scales, and one with furrowed tubercles. They are, with scales—

1. *Amphisbœna.* The one which originally got the name, is found in India: it has the scales imbricated, and moves with either end first. There are American species which differ a little.
2. *Typhlops*, blind snake, has the scales small, the tongue long and forked, the body long, and the tail rather short. Native of the West Indies and America.

3. *Tortrix*, has three large scales on the head, and the scales on the belly a little enlarged. Native of America.

With tubercles—

1. *Acrochordus*, has the whole body covered by scaly knobs. It is found in Java. It brings forth its young alive.

Q. What did you mention as the second grand division of serpents?

A. Those which have the scales on the belly different from those on the upper part of the body.

Q Does this admit of any subdivision?

A. Yes, it admits of the very important sub-division of those which have no poison-fangs, and those which have.

Q. How many genera are without poison-fangs?

A. They are variously divided; but they may, perhaps, be all reduced to these four:—

1. *Erpeton*, which have two soft prominences on the snout covered with scales; large plates on the head, and those on the under part of the tail rather small.
2. *Boa*, which are without the prominences on the snout, and have a hook on each side of the vent. Some of them grow to a very large size.
3. *Coluber*, or Python, with two rows of plates on the under side of the tail, and hooks like the boa. Sometimes larger than even the boa.
4. *Natrix*, without the hooks, but with the two rows of plates.

Q And none of these are poisonous?

A. No; but many of them are sufficiently dangerous, without poison, from their formidable teeth, of which they have several rows; the vast extent of their gape and swallow, which can take in an animal many times thicker than themselves; and the vast muscular power of their folds.

Q. Which are the most formidable?

A. The boa is the genus of which the most numerous tales are told; but it is probable that the larger colubers and it, may have sometimes been mistaken for each other.

Q. What is the size of the boa?

A. It has been actually seen upwards of twenty feet in length, and mentioned as of double those dimensions; and it is able to crush in its folds the bones of a buffalo or a tiger. It also swims with great celerity, and is as formidable in the water as on the land. When in a state of want and excitement, it is too formidable, and too rapid in its motions, to be attacked; but when gorged by swallowing a large animal, it is inactive, and can be killed without much difficulty.

Q. Are the poisonous serpents very numerous?

A. There are nearly twenty genera furnished with poison-fangs, and more or less dangerous in their bite; but the most deadly are chiefly confined to warm countries; and it does not appear that they attack man, or the larger quadrupeds, unless they are irritated. Indeed, as none of them are very large, it is not to be supposed that they would instinctively attack any animal too large for being swallowed.

Q. Which are some of the most formidable?

A. The *caudisona*, or rattle-snake, of which there are two species that differ from each other chiefly in the markings, and which, when full-grown, attain the length of six feet; they are the most formidable of the American ones. They live on birds and small quadrupeds; but when they are irritated, they bite human beings, and their bite is often fatal in a few minutes.

Q. Why are they called *caudisona*, or rattle-snake?

A. From an apparatus on the tail, consisting of a number of horny cups loosely joined together, by shaking which they make a rattling noise.

Q. Are both the species natives of North America?

A. No: the *horrida*, which has dark coloured bands across, is a native of North America, and the *durissa*, which has four-cornered spots of the same colour, is a native of the northern parts of South America.

Q. Are there any other poisonous serpents in America?

A. The *Trigonocephali*, or triangular-headed serpents, are nearly as poisonous as those that have been mentioned. One is the brown viper of Carolina; another the yellow, and a third the lozenged serpent of the West India Islands. They attain the length of six or seven feet, and their venom is very deadly. They frequent the sugar-plantations, and live upon the small quadrupeds that infest these; but when they are disturbed, their bite is often fatal to the labourers.

Q. Are there any venomous serpents in the East Indies?

A. No very hot country is without poisonous serpents. The genus *Naia*, which have the power of erecting a crest, when irritated, by inflating the cuticle of the head, are probably the most venomous; and the *cobra di capella*, or spectacle-snake, which has a dark marking on the inflated head. something like a pair of spectacles, is probably the most deadly of the genus.

Q. Are there any poisonous serpents natives of Europe?

A. The most poisonous of the European species are usually called *vipers;* and they are, generally speaking, dangerous only in the warmer countries; but there is one, the *æspic* of Sweden, the bite of which is said to be often fatal even in that cold country. It is a small reddish species.

BRITISH OPHIDIA.

Q. Are there many serpents natives of Britain?

A. Only three or four species, though there appear to be some varieties.

Q. To what genera do they belong?

A. One to the genus *anguis;* one, or probably two, to the genus *natrix;* and one, of which there seem to be some varieties, to the genus *vipera*.

Q. Which is the *anguis*?

A. The common blind-worm, which has no fangs, and no teeth on the palate, and the eyes very small, whence the common name. It does not exceed a foot in length, of which the tail occupies one half. The upper part of the body is greyish, with two dark brown lines along the back, and one from each eye, and the general colour below is brown. The tail is blunt, and the body nearly of the same thickness throughout. It is by no means uncommon in holes among trees, and under hedges and rubbish. It lives upon worms, frogs, and mice, brings forth its young alive, becomes torpid in the winter, and is perfectly harmless, though in some parts of England it has got a bad name, probably from the viper having been mistaken for it. The blind-worm is so brittle that it may be divided by the stroke of a switch.

Q. Which is the species of *natrix?*

A. The common ringed snake, *natrix torquata.* It is common in the south part of the island, but comparatively rare in the north.

Q. What sort of places does it inhabit?

A. Marshy places, and it occasionally takes the water, so that in some parts of the country it is called the water-snake.

Q. What is it like?

A. It grows to the length of three or four feet, is of dusky brown above, with two lines of black spots running the whole length, and erased by others of the same colour. The belly is mottled with black, blueish, and white, and there is a spot of yellow, and another triangular one of black upon each side of the neck. Its food is the same as that of the blind-worm; it hybernates, and is oviparous, the number of eggs being about 18 or 20. It is gentle in its manners, and easily tamed.

One is mentioned as having been met with in the south of Scotland, of a much paler colour, and with the scales much more smooth and simple on the back.

It was only about five inches long, but the species is not known, if it be not a variety of the common one.

Q. Which is the species of *vipera*?

A. The common viper, (*vipera communis*,) which has no plates on the head like the harmless snake, and is destitute of common teeth, but has poison fangs.

Q. What are the appearances of the viper?

A. The colour is not much to be depended on, as they are mentioned as yellow, black, blue-bellied, and red, all most probably varieties of our species. The want of teeth in the jaws, the smallness of the neck and gape, the greater number of scales on the belly, and the smaller number on the tail, with the absence of the horny plates on the head, easily distinguish the viper.

Q. What is the most common colour of the viper?

A Above it is of a dirty yellow, with a row of four-sided spots running into each other down the back, and a row of three-cornered ones on each side; these are black; and the portion between the eyes, and two spots on the crown are also black. The belly is dusky with a blueish tinge.

The *black* viper has the black more abundant above; the *blue* has more brown above, and more blue on the belly; and it is possible that the *red*, which is met with only in the south of England, *may* be the *æspic* of Sweden.

The great varieties of colour and marking that take place among the comparatively few species of serpents that are found in Britain, render some caution necessary in admitting many of the foreign species that have been founded upon single specimens.

CHAPTER VI.

BATRACHIAN REPTILES.

Q. WHAT are the distinguishing characters of that order?

A. Their skins are naked, or only covered with tubercles; their bones are soft; they have all tails in some stage of their existence, though many have none in their full grown state. All of them can swim, and some leap, while others crawl.

Q. What is the most general division of the order?

A. Into those that have tails in their full-grown state, and those that have none.

Q. How many genera have no tails?

A. Three, *hylæ*, tree frogs; *rana*, frogs; and *bufo*, toads.

Q. How many genera are there with tails?

A. Four. *Salamandra*, salamanders; *triton*, or efts, *proteus*, and *siren;* the last two rather obscurely known.

Q. What are the principal characters of the tree-frogs?

A. As their name imports, they live during the summer in trees; but they hybernate in the midst of lakes and rivers; and their eggs or spawn are deposited in water in the spring.

Q. What is their appearance?

A. Their colours are various, and sometimes very bright; but the body is compressed and long; there are four toes on each of the fore-feet, and five on each of the hinder. The toes are without claws: but they have tubercles, by means of which substances may be laid hold of.

Q. Are there many species?

A. There are about thirty. The greater number of which are natives of America; but some of them are common in France and Italy. They make a loud croaking in the trees.

Q. Upon what do they feed?

A. Chiefly upon insects, which they capture in the trees.

Q. Do they all pass through the tadpole state?

A. All of which the habits have been observed do, and there is little doubt as to the others.

Q. Are the common frogs as numerous as the tree frogs?

A. In individuals they are more generally distributed; but there are not so many species.

Q. What are their general characters?

A. The body is thick; the hind feet always larger than the body, and webbed between the toes; they cannot walk or climb; but they can leap and swim. They inhabit moist and marshy places, where they deposit their eggs; and when the young, or tadpoles, first make their appearance, they have oval bodies and finny tails; but when their legs begin to grow, the tails are gradually absorbed.

Q. Do not they migrate from one place to another?

A. They often do in great flocks; and as they generally march when the ground is moist after rain, that gave rise to the old fable of frogs dropping from the clouds.

Q. What is the term of their lives?

A. They are understood to live five years before they come to maturity, and live ten or fifteen afterwards.

Q. Can they be tamed?

A. Yes; they can be made so familiar as to eat out of the hand.

Q. Is not one species of frog used as food?

A. Yes; one that is green, with black spots, whitish below, and with three yellow lines down the back.

Q. Is there not one species remarkable for the loudness of its croaking?

A. Yes; the bull-frog, a large green species, which is very plentiful in the marshes and rivers of North America.

Q. Is there not a curious species in South America?

A. Yes; the Surinam frog, or Jackie *(rana paradoxica)*. The tadpole is of great size, as much as eight inches in length, and has much the appearance of a fish; but in the course of about six weeks it diminishes to half the size and becomes a frog.

Q. Do the common frogs become less when they change from tadpoles?

A. They do; but the difference is not so remarkable as in the case of the Surinam frog.

Q. What are the characters of the toads?

A. They have the body thick, short, and broad; the head of the same character; the legs better adapted for walking than for leaping; and the toes pointed and without nails.

Q. What is the appearance of their skins?

A. They are warty, and capable of being inflated.

Q. What sort of eyes have they?

A. Large eyes, with the pupil opening vertically.

Q. Do toads spit venom?

A. They do not; but when they are irritated or in danger, their skins become covered with a corrosive liquor.

Q. On what do toads feed?

A. On worms and insects; and large birds and snakes feed on them.

Q. Are they eatable?

A. Some of the species are said to be as much so as frogs.

Q. Are the toads numerous?

A. There about thirty-two species.

Q. Are any of them handsome?

A. None of them are handsome in shape; but some are beautifully coloured.

Q. You mentioned the salamander as one of the tailed batrachia: is that the animal that lives in the fire?

A. There is no animal that lives in the fire. The old story of the salamander is a fable; and the animal to which naturalists give that name, is fonder of water, though it lives on the banks.

Q. What is the form of the salamanders?

A. They are long both in the body and the tail, and thus have some external resemblance to the sauria; but their internal structure ranges them with the frogs.

Q. Are there many of them?

A. About fourteen species, six, at least, of which are natives of the south of Europe.

Q. What are the characters of the triton or eft?

A. In shape they bear some resemblance to the lizards, and have been classed with them; but they have more natural relation to the batrachia.

Q. What is *proteus?*

A. A very singular animal, found in some of the rivers on the continent. It is about a foot long and an inch broad, of a red colour, has four feet, and the tail ending in a sort of fin.

Q. Why is it called proteus?

A. Because when put in spirits of wine, it changes to a white colour.

Q. Are there more species than one?

A. There is a water animal in Mexico that seems nearly allied to the proteus of the European rivers.

Q. What is siren?

A. An eel-shaped animal found in the waters of America, which has some of the appearances of a fish, but really belongs to the batrachia.

Q. Has it four feet?

A. No, it has only two. It grows to the length of three feet, or more.

BRITISH BATRACHIA.

Q. Are there many batrachia found in Britain?

A. There are two species of frog, two species of toad, and three species of eft.

Q. Which are the frogs?

A. There are two of them :—

1. The common frog, found in all places, and—
2. The edible frog, rather rare.

Q. Are they both harmless?

A. Both perfectly so.

Q. Which are the toads?

A. 1. The common toad, which every body knows.
2. The yellow toad, or natter-jack, which is rare. It is met with on Putney-heath.

A. Are they harmless?

A. Perfectly so. The common toad is one of the most useful little animals about a garden, in clearing it of vermin, and it hurts nobody and nothing.

Q. Are there any instances of toads being tamed?

A. There have been several instances in which they have come at the call of persons, and played some tricks.

Q. Have they not sometimes been found shut up in solid substances?

A. They have been found in wood, and in holes of stones, where they must not only have lived for some time, but even grown considerably, as the opening by which they had found admission had become too small for allowing them to escape.

Q. But how could they obtain food in those places?

A. That is not so easily explained. But, as the quantity of food that animals need depends upon the waste of their bodies by breathing, by the circulation of the blood, and by action, and as those operations in the toad, are slow at any rate, and nearly suspended for half the year, it is not unlikely that, in the places that have been mentioned, very little food would be necessary.

Q. Are they long-lived animals then ?

A. They are very long-lived. Indeed, it is supposed that all the reptiles are much longer lived than the warm-blooded animals.

Q. Is there any truth in the common story of there being a precious stone in the head of the toad?

A. Not the least. There is no precious stone found in the head of any animal.

Q. Why, then, are such stories invented?

A. It is not easy to say. The habits of toads render it not very easy to be acquainted with their natural history; their appearance is ugly in the opinion of most people; and taking these two circumstances, together with the reputed poisonous nature of the toad, superstition has contrived to tell many things of it which are not true.

Q. Why should the toad have been accounted venomous?

Q. Probably from the simple fact of its being able to blow up or dilate its skin, as one means of defence against its enemies.

Q. With what is the skin dilated?

A. With air, and not with any fluid which is hurtful, though in some species the dilatation of the skin forces an acrid liquor from the pores.

Q. Which are the efts ?

A. The warty eft and the water eft, which are both inhabitants of the water; and the brown or common eft, which is an inhabitant of the land.

Q. What is the size of the warty eft

A. About six or seven inches in length. It is brownish black on the back, and orange below, and covered with warts.

Q. Where does it inhabit?

A. Ponds and marshes; but it is sometimes found out of the water.

Q. What is the water-eft like?

A. It is not much more than half the length of the other; has the back greenish brown, and the skin soft and smooth.

Q. Are these common?

A. They are both very common. The warty one in fens and marshes, and the smooth one in stagnant ponds.

Q. Are they harmless?

A. There are no accounts of harm done by either of them.

Q. Where is the common eft found?

A. Among rubbish, sometimes in cellars.

Q. Has it not been found in the winter?

A. It has not; and therefore it should probably be classed with the lizards: but, although it be very common, its natural history is very imperfectly known. It is said to be *ovoviviparous*, and to undergo no change or metamorphosis. If that be the case, it should clearly be classed with the sauria.

Q. Do not these animals get another name besides that of efts?

A. Yes, they are as, frequently called newts; and the common eft or newt is sometimes called the brown lizard.

Q. Is it harmless?

A. Even that is doubtful. There are some accounts of ill-conditioned sores upon the fingers *after* handling an eft; but it is not proved that the eft was the cause.

Q. Then how many British reptiles are really poisonous?

A. The only one that is distinctly ascertained to be so is the viper.

Q. Is there any truth in the tales which are sometimes told of insects creeping into the mouths of persons when asleep, in places which they frequent?

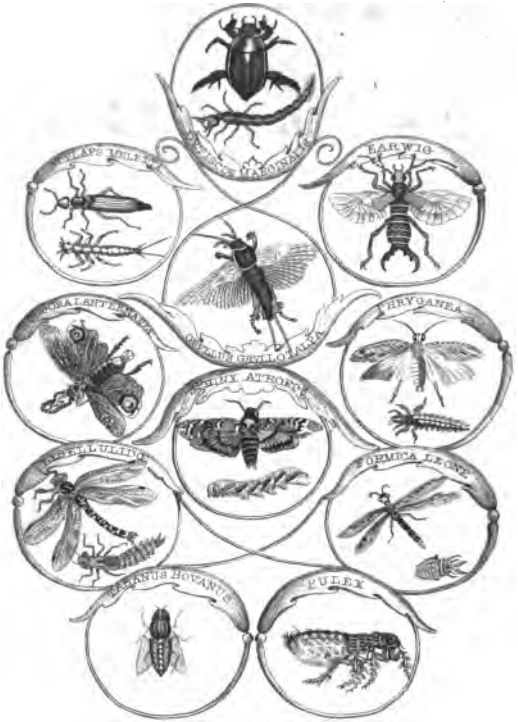
A. There is no truth whatever in them; and if there were, the animals could not live there. In no reptile is there any danger, except from the bite, or the discharge of an acrid liquor from the skin.

Q. Is there, then, any caution necessary in the natural history of British reptiles?

A. The greatest; for the subject is very little known, and has been very much misrepresented.

THE END.

LONDON:
HENRY BAYLIS, JOHNSON'S-COURT, FLEET-STREET.



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PINNOCK'S

CATECHISM

OF

ZOOLOGY.

PART V.

INSECTS.

LONDON.
PRINTED FOR WHITTAKER TREACHER & Co
AVE MARIA LANE
1831

CATECHISM OF ZOOLOGY.

PART V.

ENTOMOLOGY, OR INSECTS.

INTRODUCTION.

Q. WHAT is meant by Entomology ?*

A. The Natural History of Insects.

Q. What do you mean by insects ?

A. That class of *annulose* animals, that, in their perfect state, have air tubes for breathing, six legs, the head and thorax distinct, and two *antennæ*, or feelers.

Q. What do you mean by *annulose* animals?

A. Those animals that have their bodies marked or divided into segments crosswise, as if they were made up of rings of greater or smaller thickness, all united together.

Q. Are there more classes than one of the animals

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* ENTOMOLOGY, from the Greek Εντομα, "an insect," and λογος. Εντομα and *insectum*, though the one is derived from the other, have precisely the same meaning—that which is cut into, or notched; and therefore, *Entomology*, literally, means the knowledge of that which is notched, or partially divided into segments.

that have their bodies thus divided or marked into rings or segments?

A. Yes, there are five classes; but the more modern and accurate naturalists restrict the term insects to one of these classes, as the members of which it is composed are sufficiently numerous, curious, and marked in their characters, for requiring a particular history.

Q. Mention the names of the other classes, and point out in what they differ from insects properly so called.

A. They are:

1. *Crustacea*, which have gills for respiration, and legs for motion either in the water or out of it, but never any wings. They are covered with crusts, which vary in their texture, from a flexible membrane to a hardness approaching to shell, and getting that name in common language.
2. *Arachnides* (spider tribe). They have air tubes, not gills, for breathing; they have six legs, or eight, they have the head and thorax united, and they have no antennæ or feelers on the head.
3. *Myriapoda* (many feet), having some of the characters of the crustacea, but differing from them in not having gills. They have always more than eight legs.
4. *Vermes* (worms). They are destitute of feet and antennæ, and breathe by air tubes.

Q. Are insects considered, in this limited view of them, a numerous race of animals?

A. Their numbers, both in species and in individuals, are very great, all parts of the world teem with them. They are probably more numerous than any other class of animated beings; and as they are, generally speaking, endowed with great activity and strength in proportion to their size, it is by no means improbable that they perform the greatest portion of animal labour.

Q. That which they perform individually is not very great?

A. It is not, considered in itself, but when we compare that which many insects can do, with their own bulk, we find that it is far greater in proportion, than what is done by horses, elephants, or lions. While the flight of the swallow or the eagle is nothing in comparison with that of some of them.

Q. Are there many inducements to the study of insects besides their great numbers?

A. It is not possible even for imagination to picture or invent a wish that may be not gratified merely, but altogether surpassed, in the study of insects. Their forms are the most varied, and at the same time the most curious, that can be imagined; their colours are the most splendid; their actions are the most lively, and many of their performances are the most ingenious and absolutely surprising that man can meet with—the very perfection of his art, after all the science by which it is directed, is nothing to many of the instinctive performances of insects—to those performances which they accomplish even in the dark, and with neither an instructor to direct, or a tool to assist them.

Q. What then prevents insects from being so much studied and admired as some other classes of animated beings?

A. One cause is, no doubt, their diminutive size. With the rude and uncultivated, mere magnitude is a source of wonder and admiration, and in that respect insects fall far behind many other animals that they far outstrip in elegance of form and beauty of colours, activity in movements, and ingenuity in action.

Q. And has this prejudice in favour of mere bulk many pernicious effects?

A. There is nothing that has more mischievous influence than mere size. When the very illiterate speak of any thing of which they do not know the origin, the parties to whom they are most apt to attribute it are giants, men of more than ordinary size, without any reference to their superior skill or knowledge.

Q. Is there any further intellectual advantage in the study of the small things of the creation?

A. There is. When we find equal or superior mechanism to that which we find not only in the most ingenious structures which man can fabricate, but to that which we meet with in what we are accustomed to call the larger and more perfect animals, in a little thing whose whole volume is but as a fraction of a grain of sand, we cannot fail in being struck with admiration, not of the degree merely, but of the kind of that wisdom and power which are developed in the works of creation, which, in the emphatic language of Holy Writ, hath as it were, "chosen the weak things of the world to confound the things that are strong."

Q. Are there any uses of the study of insects?

A. It is not possible to study any part of nature without finding many useful things in it, and in a portion which is so large, and so generally diffused as insects, the uses must be corresponding.

Q. And are the insects themselves of much use?

A. Their uses in the economy of nature are, of course, in proportion to their numbers, and we are indebted to them for some of the finest and most valuable substances used in the arts.

Q. Can you mention any of their natural uses?

A. Insects are the grand scavengers of nature—the principal agents in keeping the world clean.

Q. How does that appear?

A. Whenever any substance begins to putrify, and would, by the vapours that it gives out, render the air tainted and unwholesome for the larger animals, insects crowd to it in vast numbers, and either consume it themselves, or deposit their eggs in it, which are speedily hatched, and it is soon consumed by the young ones.

Q. Do they answer any other purpose in this way, than the mere consuming of that which is disagreeable?

A. The subject has not been studied with that attention which it deserves, but we have every reason to conclude that insects contribute not a little to the fertility of the soil, and thus to the growth of plants, the nourishment of the larger animals, and the wealth and comfort of man.

Q. How can that be?

A. There is nothing more clear and simple. Ever-one who is in the least acquainted with agriculture or gardening, knows that animal and vegetable substances in a putrifying state, if they are not directly the food of plants, are the means by which plants grow, and land, which in its natural state produces nothing that is useful, or even nothing at all, is made to pasture herds and yield crops.

Q. That is all very true, but what have the insects to do with it?

A. They perform two very important operations: they hasten the process of decomposition, and they prevent those parts which, from their active nature, are the most valuable, from being scattered to the winds.

Q. How do they hasten the decomposition?

A. They, or the produce of the eggs which they deposit, drill the substance into holes, or reduce it to powder, and thus they not only decompose it themselves, but expose it more freely to the action of the air and the water.

Q. And how do they prevent it from being wasted?

A. The juices are the parts on which they live, and if they were not consumed by them, they would be converted into gases or airs, and scattered through the atmosphere. Wherever there is fertile ground there are insects, and where no insects are, the ground is invariably barren, without plant or animal.

Q. But are not insects often very destructive, the locusts in many countries, and various sorts of caterpillars in all countries, destroy the labours of the husbandman, and even the entire verdure and herbage of the country?

A. Locusts do occasionally commit terrible ravages in some countries, but even there it is doubtful whether they appear more in the character of destroyers or of benefactors. The locusts are wholesome and nourishing food to the people, and that which they consume is not, or only partially so.

Q. And do the people eat locusts?

A. They do, and have done so in some countries from the earliest records of history. The ancients mention the Acridophagi,* or locust eaters, as a particular nation, who had their distinguishing name from that very circumstance.

Q. Is that not one of the fables of ancient history?

A. The fable is all the other way. The name of the locust has been associated with famine and pestilence by poetic writers. All the accounts and the popular feeling respecting it, are revolting in the extreme, but there are still many places of the world where the locust establishes its claim to that benediction which the Almighty pronounced on all that he had made.

Q Are there any modern nations that live upon these insects?

A. The inhabitants of Syria and Arabia, and of many of the regions bordering upon the great African desart, not only occasionally live upon locusts, but find them their most savoury and delicious viands. They are publicly sold in the markets, and upon some occasions made into bread.

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* Acridophagi—from the Greek Ακριδ, a locust, and φαγα, I eat. See Diodorus Siculus, lib. xxiv, cap. 3. Hasselwist's Travels, *passim*.

Q. How do they taste?

A. The taste of them is very similar to that of shell-fish, and there is no doubt that many of the insects that are found in other countries would prove wholesome and excellent food, were it not that people have prejudices against them.

Q. What reason have we for thinking so?

A. The quadrumana that do not in general live upon animal food, are fond of insects, and eat them in preference to any thing else. Many small quadrupeds, very many of the reptiles, many birds and fishes live upon insects, and not a few have their feeding apparatus so constructed as that they can live upon nothing else.

Q. Then insects are an essential part of the creation?

A. They are so essential a part, that without them it does not appear that the general economy of Nature could be carried on.

Q. But the insects that eat the leaves and buds of our flowers and fruit-trees, cannot be useful?

A. They whose plants and trees they injure, naturally enough suppose that they are not, just in the same manner that a traveller does not easily see the use of the rain which drenches him to the skin; but the feelings of the human beings that may happen to be interested, have nothing to do with general usefulness in nature, and very often not much with particular usefulness to themselves.

Q. What usefulness can there possibly be in eating the leaves and blossoms of fruit-trees?

A. Though we cannot point out the uses, we are not warranted in concluding that they do not exist. Gardeners find that the whole crop upon their trees is not only better in quality, but more abundant, when they thin both the leaves and the blossoms, and that is at least a reasonable ground for supposing that the thinnings effected by insects may have similar and even more extended uses.

Q. What conclusion might be drawn from that?

A. A most important one, were we wise enough to attend to it—namely, that in every pursuit and occupation of life in which we can engage, the knowledge of nature, not in partial portions, or in those that strike the fancy and arrest the attention, but in all the varied forms that exist, and in all their modes of existence and their connection, is so absolutely necessary, that if we have it not, the harm that we may do, even with the very best intentions, may greatly exceed the good.

Q. But are there any direct uses of insects?

A. Yes. We are indebted to an insect for the very ink with which we write, and without the labour of that insect we could obtain no substance that, at so small cost, and with so little labour on our part, would answer the purpose.

Q. Is not that somewhat singular.

A. Not more singular than true. Ink, and indeed many black dyes, are formed of iron precipitated by gallic acid* and tannin; and this acid and tannin are no where found in so convenient a quantity or proportion, as in certain preparations by insects.

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* See Catechism of Chemistry.

Q What are those preparations called?

A. They are called galls, and as they are formed on oak-trees they are called oak-galls.

Q. By what are they formed?

A. They are formed by different species of *cynips*, which are small flies very much divided at the middle, and all deposit their eggs in substances that are fitted for the support of their young when they are hatched. This fly has a crooked instrument with which she can puncture the leaves and other parts of plants, and lodge her eggs under the epidermis.

Q. Where, of course, they remain till they are hatched?

A. In general they do; but that is not the most remarkable part of the matter. Small as the fly is, and minute as is the puncture which she makes, and the egg which she deposits, the puncture and the egg have the effect of causing a ball of matter of the size of a nut or larger, to grow upon the place. This ball of matter is what is called the *gall*. It gets that name from its bitter and astringent taste, and it contains more of the principle that combines with the oxides of metals, and forms a blacker dye than could be obtained from a much larger quantity of oak leaves, or oak-timber.

Q. And are those galls found in large quantities?

A. In quantities so large that they form an important article of commerce, and are used in dying, ink-making, medicine, and for many other purposes.

Q. Are they produced in England ?

A. Galls are produced in England, upon oaks, willows, and other trees, but those which are of the greatest value, and chiefly used in the arts, are brought from the countries immediately to the east and north-east of the Mediterranean.

Q. Are there any other uses of insects ?

A. They also furnish the finest red dyes, which are the insects themselves in substance, and not any gall or excrescence which they form upon plants.

Q. Do not the insects which furnish these colours inhabit plants ?

A. They do. One of them inhabits the twigs of a kind of oak which grows on the shores of the Mediterranean, and the other the *cactus*, a prickly, leafless plant which grows in the temperate parts of America. The former is called *kermes*, the latter *cochineal*. The insects that form both are small, and belong to the same genus as the " lady-birds" that are so common in this country.

Q. And a e there any uses of insects besides food and dyes ?

A. To insects we are wholly indebted for silk, at once the strongest, lightest, and most beautiful article that is used in clothing, the preparation of which gives employment to many thousands of people, and the machinery by which it is prepared is among the finest specimens of mechanical invention.

Q. You mean silk, I presume ?

A. Yes. All the silk that is used, and the quantity is very great, is first spun by the caterpillar of a moth, called the silk-worm, as a temporary clothing for itself.

Q. Are there any further uses?

A. There are many still behind. The honey of the bee is well known to every body, and to those cottagers that have sense enough to attend to their cultivation, bees are a source of great profit. Bees are also the grand collectors of wax, which is used for so many purposes in the arts.

Q. You do not mean sealing-wax?

A. That is not the wax to which I alluded, but for the best qualities of the best sort of sealing-wax, we are also indebted to insects.

Q. To what insect?

A. To the *coccus lacca*, which inhabits trees in India and some of the adjoining countries, and builds little combs or cells for its eggs and young, of the substance which is called lac, and which forms the basis of sealing-wax, and is an ingredient in some of the best and most durable varnishes.

Q. Considering the great number of insects that there are, are not these but few uses?

A. The uses to which human skill and industry have applied insects, are certainly but few, as compared with the number and variety of the animals; but the fault appears to be in man, and not in the insects. The uses that have been found out are much more important than, from the smallness of the animals, one would have been led to suppose; and there is little doubt that observation will lead to further useful applications.

Q. What is there to be studied in the natural history of insects?

A. First, their general structure and habits, and then the classification, as in the case of every other description of animals.

Part I.—Formation and Habits of Insects.

Sect. I.—Structure of Insects.

Q. Is there any remarkable difference between the structure of insects, and that of vertebrated animals?

A. They differ from these in having no bones internally, but being supported wholly by the skin.

Q. Of what is the skin of insects formed?

A. Of a substance resembling horn in its composition, but which is thick or thin, hard or soft, according to the species.

Q. Is it never hard, like bone?

A. It is in many instances harder than any bone, if perhaps we except the enamel of teeth; but it is considered as being, even in these cases, wholly made up of animal matter, and not containing any salts of lime.

Q. With what appendages is the covering of insects furnished?

A. With various appendages, from spines that are so large and hard as to be capable of inflicting severe wounds, to hairs of so much minuteness as not to be visible without the aid of glasses. The spines, bristles, and hairs of insects do not merely grow in the skin, as is the case in the mammalia—they are parts of the skin itself, and therefore not liable to be rubbed off.

Q. Are not parts of the coverings of some insects very easily rubbed off, or destroyed?

A. Yes; but the parts which are so delicate are scales, or, sometimes, from their form, they might be called feathers. In the wings of moths, these are very beautiful when magnified, though to the naked eye they appear to be only a very fine powder.

Q. You mentioned that insects derive their name from being "cut into, or notched"—is that very apparent?

A. Yes; the body is always made up of four pieces, or rings; but the distinction between the second and the third is not always so conspicuous as the others.

Q. What names are given to these rings or divisions?

A. The first one is the *head;* the second, the *thorax;* and the third, the *breast;* and the fourth, the *abdomen.* The thorax and breast form the *trunk;* and sometimes the one, sometimes the other, is largest.

Q. And the external covering of these rings or divisions forms, as it were, the skeleton of the insect?

A. It does. All the muscles by which the different parts are moved, are inserted at their extremities, immediately in the skin, and without any tendons.

Q. And how are the different rings united together?

A. When they are hard, the skin at the points of union is softer, and allows of various degrees of motion, in which state it is called ligament. These ligamentous junctions are often, as may be seen in ants, and especially in wasps, very slender as compared with the rings which they unite.

Q. What does the head present externally?

A. The organs of the senses, and the mouth with its accompanying organs.

Q. What part does the *thorax* occupy?

A. Immediately behind the head, and has the fore-legs, or first pair of legs, united to it on the under side. It often has a horny keeled sternum between those legs, and also a horny shield on the upper surface.

Q. What is the situation of the *breast*?

A. Immediately behind the thorax, to which it is joined, and the joint has often less motion than any of the others.

Q. What are the appendages to the breast?

A. The second and third pairs of legs on the under side, and the wings on the upper; and it has frequently a horny process on the upper part, which is called the *scutellum*, or little shield, and sometimes a pectoral sternum on the under side, which covers the first joints of the hind legs, and also a part of the abdomen.

Q. Where is the *abdomen* situated?

A. Immediately behind the breast, and connected with it, sometimes *sessile*, or close, so as to admit of very little motion, and sometimes with a slender stalk.

Q. Of what is the surface of the abdomen made up?

A. It is made up of rings, the number of which, and also the mode of their junction, varies much.

Q. Are any of the *members*, or organs of motion, articulated to the abdomen?

A. None, in any case; but the abdomen is often beset with bristles; and when the animal has a sting, the extremity of the abdomen is armed with that.

Q. How are the muscles that move these rings inserted and arranged?

A. The thorax contains the muscles for moving the head and fore-legs, and the breast those for moving the back two pairs of legs, the wings, and the abdomen. It has also some cross-muscles, by the action of which the upper and under sides can be brought nearer to each other. There are also small muscles in the abdomen that give slight motion to the rings of that.

Q. How is the muscle inserted in the two adjoining pieces?

A. If the muscle is to pull any part in a particular direction, it is inserted on the opposite side of that part, and crosses through the junction to the opposing side of the other part. Thus a muscle for pulling the head downward, passes from the upper part of the head to the lower part of the thorax.

Q. How far does the action of one muscle extend?

A. As there are no tendons, only to a single joint; the muscles in the trunk, for instance, move only the first joints of the legs; those in the first joints move e second joints, and so on.

Q. What are the members of insects?

A. They are feet and wings.

Q. Which of these are most simple and uniform in their character?

A. The feet which are always six in number, and made up of the same number of parts, though they differ considerably in their form and appendages.

Q. What are the parts?

A. They are the hip (*coxa*), the thigh (*femur*), the leg (*tibia*), the toe (*tarsus*), and the claw (*unguis*), which regularly follow each other from the insertion of the coxa to the trunk, to the extremity of the unguis, which terminates the number.

Q. What is the character of the coxa?

A. It is generally short and thick, often lying in a groove in the trunk, and sometimes the coxæ of the hind legs are united into one solid piece with the sternum of the breast; but sometimes it fits into a cup-shaped cavity, and has considerable motion.

Q. What is the character of the femur?

A. It is longer than the coxa, and usually articulated to that, so as to have motion only backwards and forwards.

Q. What is the character of the tibia?

A. It generally moves only in the same plane with the femur.

Q. What is the character of the tarsus?

A. It is a much more curious structure than any of the others, consisting of a number of pieces loosely jointed together, and admitting of motion in all directions.

Q. Are there more appendages to this part of the foot?

A. There often are, besides bristles, spines, and hairs of various sorts, very curious ones in the form of cushions, suckers, and other contrivances of the most ingenious description.*

Q. What are the uses of these?

A. The cushions, by their elasticity, break the fall of the animal when it alights forcibly on a hard or rough surface, and the suckers enable it to fasten its feet to smooth surfaces, or to walk with its back undermost.

Q. What are the characters of the unguis or claw?

A. They are various. Sometimes there is but a single claw which acts against a process or knob, that answers for a thumb; sometimes there are two claws acting in the same direction, and also against each other, and sometimes the claw is broad and toothed.

Q. Are any general characters of insects formed from the appearances of the feet?

A. There are. Where the femur is slender and of uniform thickness, the whole foot is fitted only for walking; when it swells out in the middle to give room for the bellying or contraction of the muscles that move the leg, the animal can leap, and the distance to which it can leap is in proportion to the bellying of the former and the length of the leg.

Q. Are there any particular characters in the tibia?

A. If the insect is to inhabit only the surface of the earth, the tibia is plain, or has only bristles; if it is to dig in the ground, the tibia has a strong toothed edge; and if it is to swim in water, the tibia is flattened like an oar.

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* See Philosophical Transactions for 1818.

Q. Are there many differences in the wings of insects?

A. There are a great many, in the number, the form, the texture, and the arrangement; and as these are very obvious differences, they are of much use in forming the greater divisions in the classification of insects.

Q. What are the principal differences in the wings?

A. Some insects are without wings altogether; and these are called *aptera*,* or apterous insects.

Q. When they have wings what are the characters?

A. Some have only two wings, and they are called *diptera*, or dipterous insects, from the Greek name for having two wings. Others have four wings.

Q. Are there any distinctions among those that have four wings?

A. There are. In some the wings are composed of a simple membrane stretched out upon a framework of ribs of a horny matter, which are, though very improperly, called nerves; and the insects that have such wings only are called *neuroptera*, or neuropterous insects, that is, insects with nerved wings.†

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* *Aptera*, from the Greek, α wanting, and πτερα a wing, literally "wingless."

† The dragon flies have this character.

Q. Are there any other distinctions ?

A. Yes. Some insects have the upper pair of wings not at all adapted for flying, but consisting of hard cases of the consistence of horn, which completely close upon and shield or protect the other and membranous pair that are adapted for flying; and these are called *coleoptera*, or coleopterous, that is sheath-winged insects, the sheaths themselves being called *elytra*, or coverings.

Q. What is the common name given to the coleopterous insects?

A. They are usually called beetles; and their elytra shut so neatly together over the wings, that the latter are wholly concealed, and the wings sustain no injury, even when the beetle burrows in the earth, or dives under the water.

Q. Are there other distinctions of the wings ?

A. Yes. Some insects have the upper wings of a leathery consistence, or intermediate between membrane and crust; and these are called *hemiptera*, or half winged. The bug and the locust are specimens of this kind.

Q. Are there still other distinctions ?

A. Yes. Insects which have four wings of membrane, but without the reticulations or nerves which characterise the neuroptera are called *hymenoptera*, or membranous winged insects.

Q. Which are some examples of these ?

A. The bee, the wasp, and many others.

Q. Is there still any other distinction in the wings ?

A. Yes. Some insects have the wings covered with delicate and often very beautiful scales; and these are called *lepidoptera*, or scaly-winged insects. The moths and butterflies are examples.

Q. Are those differences in the wings of any use in the classification of insects?

A. They are. They were the foundation of the seven orders, into which insects were divided by Linnæus; and though later naturalists have separated from his wingless class, some animals, such as crabs and spiders, which are not properly insects, and made some further arrangements, the Linnæan classification is still the most simple and convenient for beginners.

Q. Why so?

A. Because though the peculiar character of the wings does not always afford a guide to the character and habits of the insects, it is so simple that it cannot be mistaken.

Q. Repeat the names and characters of the wings in the seven Linnæan Orders?

A. They are these.

Order I. COLEOPTERA, wings with horny covers.

Order II. HEMIPTERA, upper wings leather-like.

Order III. LEPIDOPTERA, four wings powdered with scales.

Order IV. NEUROPTERA, four naked wings, stretched on a net-work of fibres.

Order V. HYMENOPTERA, four naked wings with the fibres less conspicuous.

Order VI. DIPTERA, with only two wings.

Order VII. APTERA, having no wings.

Q Are not there some additional appendages to the wings of insects?

A. Yes. In the *diptera* there is generally behind each wing a little stalk with a knob at the end. These are called *halteres* or poisers; and between the poisers and the basis of the wings there are generally little spoon-shaped scales, but these are not constant in the diptera, and some of the coleoptera have them.

Q. Where are the muscles that move the wings of insects situated?

A. Always in the breast, or second ray of the trunk, and in some of the species their power of motion, both in rapidity and continuance, is almost incredible.

Q. Which are the slowest flyers?

A. The coleoptera, which may be considered rather as inhabitants of the earth and the water, and only passengers through the air from place to place.

SECTION II.—SENSATION OF INSECTS.

Q. What are the organs of sensation in insects?

A. A nervous system, as in the other animals; and in the whole of the varied tribes of insects that system is remarkably uniform as well as simple.

Q. Have insects a brain?

A. Yes. The brain consists of two lobes situated in the head and on the upper side of the entrance of the gullet, and giving out nerves to the eyes, and generally also to the mouth.

Q. What are the other parts of the nervous structure?

A. Two cords, which, however, are sometimes so united as to appear only one, descend from the lobes in the head, to the extremity of the body, and have some resemblance to a spinal marrow; but they are supported rather by the gullet and intestines, than by the hard parts.

Q. Is there any peculiar formation of this nervous cord in the wings?

A. Yes. In each ring or segment of which the the body is made up, the cords form a *ganglion* (a knob or knot), from which all the nerves that are required for that ring issue.

Q. Is each of these ganglions to be considered as a separate brain?

A. No. They are merely parts of a system, the centre or most important part of which is the two lobes in the head, for if these are injured the action of all the others is destroyed. Every insect is thus one animal, and though, in certain stages of their being, many of them can reproduce some parts, there is no instance in which the head can be reproduced.

Q. Have they the same organs of the senses, as in the warm-blooded animals?

A. The organs of vision and touch are local, and very easily seen and examined; but the organs of the other senses have not been traced, so that the possession of them is rather inferred from the habits of the insect than known to exist.

Q. What are the characters of the eyes?

A. Insects have often two kinds of eyes, and some of these are among the most curious structures in nature.

Q. What are those two kinds of eyes?

A. They are simple and compound.

Q. What is the form and structure of the simple eyes?

A. They are usually round black dots, three in number, and situated in the upper part of the head; but in several species they are wanting.

Q. And the compound eyes?

A. They are always present, generally one on each side of the head, but sometimes each is so divided by the marginal band of the head that there appear two on each side. Sometimes those eyes are raised on pedestals, sometimes they are level with the head, and sometimes they are embedded in cavities.

Q. What appears to be the uses ot the two sets of eyes?

A. The simple ones enable the animal to see upward, the compound, laterally and below. When Cuvier covered the compound eyes of a wasp, it flew directly upwards; when he covered the simple ones also, it did not attempt to fly at all.

Q. Of what do the compound eyes consist?

A. Externally they are made up of a vast number (sometimes several hundreds) of little faces or discs, all rising in the middle, and generally regular six-sided figures, with grooves between them, which are often very beautifully studded with minute hairs. All these are united into one horny plate of very transparent texture, but each of them appears to be capable of vision, and has a nervous prism under it for communicating the sensation.

Q. Are these compound eyes fixed or movable?

A. In insects they are generally fixed.

Q. Can they see far?

A. That is a part of the subject on which information is very much wanted. Bees go out to gather honey and return to their hives with great certainty from the distance of miles, and after more doublings and beatings from place to place, and from blossom to blossom, than would quite bewilder man; but if they do that from sight they must have very little memory, as the same bee may be observed to return again and again to the same flower from which it has just before drained the honey.

Q. What are the organs of touch?

A. It is by no means improbable that the toes, where these are not of a horny consistency, and also the tips of the wings in many insects, may have a power of touch, but the principal organs of touch are understood to be the *antennæ*, or feelers.

Q. What is their number and situation?

A. They are always two or more in number, situated on each side of the head, usually between the eyes and mouth.

Q. What is the form of the *antennæ*?

A. They always consist of a number of pieces or joints, which the insect has the power of moving.

Q. And how is it inferred that they are organs of touch?

A. When they come to any body they may be seen examining it with their antennæ in the same way that a man would with his finger; and when those of the same species meet they examine each other in the same manner.

Q. Which of them appear to have the antennæ in the greatest state of activity?

A. Those which live upon, and especially those that live in the ground, or have to find their food in the dark.

Q. Have they any organs of smelling?

A. That they have a sense of smelling can hardly be doubted, as they are evidently attracted to many substances where it is difficult to imagine that there can be any other attraction than the sense of smell; but where that sense resides, whether in the palpi with which the mouth is furnished, or in some other part of the body, has not hitherto been, and probably never will be determined.

Q. Then they have no nostrils?

A. No; there is no passage of air by any opening in the fore part of the head of insects, they breathe by means of spiracles or holes in the sides of their bodies; and it may be that the organs of those senses which are not found anywhere else, *may* be connected with these spiracles.

Q. Why may that be the case?

A. The air is the medium both of scent and sound, the two senses for which they have no visible organs, and as the organs (of scent especially) in those animals that have them clearly determined, have them in the air passages, it is not unreasonable to think that insects may also have them there.

Q. What reason is there to conclude that they have organs of hearing?

A. Many of them emit voluntary sounds upon particular occasions, which are answered by others; without hearing, the sound would be useless, which is contrary to the whole economy of nature, in which there is nothing useless, and besides an unheard sound could not be answered.

Q. Have they voice?

A. No. As they do not respire by the mouth they can have no voice, and thus the sounds which they emit are always produced either by the motion of some parts of their bodies in the air, as in the humming made by the wings of bees, or by rubbing one part of their body against another, or against other substances.

SECTION III.—NOURISHMENT OF INSECTS.

Q. Are there many things to be noticed in the manner in which insects are nourished?

A. Their mouths are generally composed of the same number of parts, but these are so differently formed as to admit of three distinct classes, from the consistence in which they receive their food.

Q. What are these?

A. The simplest English names that can be given to them are *gnawers*, *lickers*, and *suckers*, each of which has, of course, a particular modification in the parts of the mouth.

Q. Of what parts is the mouth generally speaking made up?

A. Of four; but as there are no common English names for them, they are expressed by the Latin ones of *labrum*, *mandibulæ*, *maxillæ*, and *labium*,—the first and last single, and the second and third in pairs?

Q. What is the *labrum*?

A. The labrum is joined to the fore part of the head, and occupies the same place as the upper lip of the mammalia, fishes, and reptiles. It is variously formed, and constitutes one of the distinguishing characters of the several species.

Q. What is the motion of the labrum?

A. It opens upwards and closes downwards, and may be considered as the cover of the mouth from the upper part.

Q. What is the arrangement of the *mandibulæ*?

A. They are articulated one on each side below the labrum, and move horizontally or in a direction contrary to the jaws of the vertebrated animals, and the mandibles of birds.

Q. Of what are they composed?

A. Generally of a horny substance, very variously shaped in the different species, and often so hard and strong as to cut the toughest, and knaw the hardest of organic substances. They often cross each other like the blades of scissars, and at other times they resemble claws acting against each other.

Q. What is the arrangement of the *maxillæ*?

A. They are articulated to the cheeks immediately under the mandibulæ, and also act horizontally.

Q. Are they as simple in their structure?

A. In general they are not. Their inner margins are generally beset with stiff hairs; and on their outer sides, they support the *palpi*, which are appendages consisting of two joints and sometimes more.

Q. How many palpi are there?

A. Generally one on every maxilla, but rarely more than one.

Q. What is the use of the palpi?

A. The uses of the palpi are but imperfectly known; but it is probable, that like the antennæ, they are organs of touch, and probably also of smell, though the latter has not been ascertained.

Q. What is the place of the *labium*?

A. The labium is in the place of an under lip, closing the mouth, from the underside upwards. On each side it has a palpus of two or three joints, and at the middle there is a line, as if it were partially divided into two; at the sides it is jointed to the maxillæ, and at the back part to the head, through the medium of a plate.

Q. And have those organs always the same arrangement?

A. There are in all classes rudiments of them all, but they are perfect and capable of dividing hard substances, only in those insects which gnaw solid food, or at least food that requires some force to divide it.

Q. What are their characters in those insects that procure their food by licking?

A. In those, which are chiefly the hymenoptera, of which the bee may be taken as a type, the labrum is changed into a soft or fleshy plate, which can be applied in licking in the same manner as the tongues of quadrupeds, and capable of being rolled up inwards when not in use.

Q. What is the form of the mouth in the suckers?

A. There are two important modifications of the parts in these. In the first of these the labrum is nearly obliterated; the labrum produced, formed with a groove on the upper side, and called the beak *(rostrum)* when hard, and the snout *(proboscis)* when soft; and the mandibulæ and maxillæ are elongated into plates, or rather hairs, and imbedded in the grooves.

Q. In which classes of insects are those characters chiefly found?

A. In the *hymenoptera* and *diptera.* If the labrum forms a hard rostrum, the sucker is often, as in the case of the *tabane*, employed in perforating the skins of animals and sucking their blood; and when it is soft it is chiefly used for sucking up moist substances, as in the case of the common house-fly.

Q. What is the second form of the sucker?

A. In that the labrum is short, and the two maxillæ are so applied to each other, that by means of a groove in each, they form a sucking tube, which when not in use is coiled up spirally.

Q. To which class does that chiefly belong?

A. To the lepidoptera; and it is not in any known species of so hard a consistency as to penetrate a solid substance.

Q. Then the Linnæan distinctions of the orders by the wings, have some correspondence to the feeding-apparatus, and on that account to the modes of feeding?

A. The correspondence is not so general or so perfect, as to render the arrangement a natural one, but there is a considerable resemblance in some of the particulars.

Q. What is the general gradation?

A. The coleoptera have the mouth invariably fitted for cutting and gnawing; many of the hemiptera have the same character; the neuroptera follow, and still have, in some of the species, the power of biting or gnawing; then the hymenoptera and diptera, are adapted for licking and sucking, and the lepidoptera chiefly only for sucking fluids, so that in the perfect insects those that have the most hard matter in the wings, have also the mouth best adapted for gnawing hard substances; and in proportion as the entire wings become soft or scaly, the animal is in general more restricted to liquid food.

Q. Are the digestive organs of insects as varied and complicated as those of feeding?

A. They are not, the gullet is simple; and though there is sometimes a tubercle in the under part of it, which holds nearly the same position, it can hardly be considered as a tongue.

Q. How are the heart and blood vessels arranged?

A. No heart or blood vessels, and no absorbent system, by which the nutritive part of the food of insects can be conveyed into the system, have been discovered.

Q. How, then, are they nourished?

A. It would seem that the matter fit for circulation, passes from the intestinal canal into the cavity of the body, where it is acted upon by the air in the air-tubes, that proceed from the spiracles or breathing-holes in the sides, and are ramified all over the body: and that probably a portion of it is converted into fat n the *dorsal vessel.*

Q. What is the dorsal vessel?

A. A little one, seated within the body near the back, surrounded with fatty matter, and containing a liquor that appears to have a considerable resemblance to gum.

Q. May not this vessel be the heart?

A It does not resemble the heart of any other animal, neither is it connected with any vessels for circulation, though it is much connected with the air-tubes, with nerves and with muscles.

Q. What are the lungs of insects?

A. They are the air-tubes or vessels that have been mentioned; they spread through the whole interior, and open outwardly by the *stigmata* or breathing-holes in the sides, which are formed of cartilage, and often have little valves, by means of which they can be shut or opened.

Q. Then the muscles, the nerves, the intestines, and the air-vessels, are imbedded in a fluid, which occupies the rest of the cavities?

A. Just so: and after this fluid has been freed from its superfluous carbon, by the action of the air in the tubes or tracheæ, the proper organs elaborate from it the portions which are fitted for the different purposes of the animal.

Q. Is that the invariable structure of insects?

A. In some stages of their existence, some of them have other organs by which silk, gum, and other fluids, or it may be the same fluid in different states, is prepared.

Q. What constitutes the food of insects?

A. Almost every organic substance that can be imagined. The blood of large animals, the bodies of other substances, all manner of vegetable matter, substances in a state of putrefaction; and indeed, with the exception of stones and metals, almost every substance that can be mentioned. Stones, indeed, hardly form an exception: for although they do not absolutely cut stones, they can gnaw or scrape them to powder for some of their other purposes.

Q. Of what kind of substance are the bodies of insects formed?

A They have not been analyzed with the requisite degree of care, but the probability is, that they are chiefly made up of albumen and gelatine, which may be among the reasons why they are so eagerly sought for as food, by so many animals, and why the few that man has introduced into his systems of cookery, are so nutritious.

Q. Are there no poisonous qualities in insects?

A. Some of them are so acrid that they are employed in medicine for blistering the skin; many of the hymenoptera are furnished with strong acid or poison apparatus; and some of the coleoptera also secrete poisons or at any rate acrid juices.

Q. Are any of them endowed with electric powers?

A. There are some facts mentioned with regard to species in the warm countries that lead to the suspicion that there may be such a power, but these facts have not yet been followed out. The fact is, that it has been more the fashion, especially in England, to collect insects for the beauty of their colours, than to acquire a knowledge of their qualities and habits.

SECTION IV.—REPRODUCTION OF INSECTS.

Q. ARE all the species of insects in two sexes?

A. All that have been hitherto discovered are; some indeed have neuters, and very many in certain stages of their being, have no distinctions of sex.

Q. You have qualified other expressions besides that with the words " in certain stages of their being," what do you mean by those words?

A. In insects we meet with changes from one state of being to another, which are very singular and would alone be sufficient to lead any rational person that was ever so slightly acquainted with them to study their economy.

Q. Are these the changes of youth, maturity, and decay, as in the mammalia; or of the egg and the chicken, as in birds; or the spawn, the tadpole, and the frog, as in the batracian reptiles?*

A. They are much more curious than these. The lamb differs from the sheep in little else than size and strength; the chicken wants but to grow and to be fledged; and even the tadpole has some points in common with the frog; but the changes which an insect undergoes, are often so great, that if the facts were not known, the identity of the insect would be altogether incredible.

Q. Mention one of them?

A. Some of them live for seasons in the earth or the water, in the state of loathsome grubs or caterpillars; and then come to the light, winged creatures, adorned with the most beautiful colours, capable only of sucking the most delicate liquids, wanton for a very brief space in the sunshine, and then die.

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* See Catechism of Herpetology.

Q. How are insects produced?

A. They are in all cases produced from eggs, and generally those eggs are deposited by the mother, which dies in the meantime, and leaves them to be hatched by accidental causes; but there are some species which, in the warm weather, are *ovaviviparous*, or hatch their eggs before they are laid, though in the cold weather the very same species connect their eggs to those substances that are fit for receiving them, and die.

Q. That is very singular?

A. But it is not the most singular part of the matter. Of the *aphides* (little things not bigger than grains of dust, that are met with upon the buds of roses, and the leaves and young shoots of many plants, in such numbers as to be pests to the gardeners), there are many in which there are no males till near the ninth or tenth generation, and it does not appear that any would be necessary to continue the race for ever, were it not for the cold weather of autumn, by which the whole living myriads are destined to be killed, and the race must be preserved by eggs of a different kind than those that answer in the summer months.

Q. Is there any parallel case in nature?

A. None in the animal kingdom, and of course none exactly parallel any where The nearest approximation is in those plants, which, like the potatoe, can be reproduced by parting the roots.

Q. And as the great mass of insects die, you say, before their young are hatched, do they take no care of them?

A. In most species their habits are so different, that the parent could not only take no care of the young, but could not exist for a moment in that element to which alone it is adapted.

Q Can you mention any instance?

A. The gnats, which make the sunbeam gay with their sportive thousands, and weary the night with their ceaseless song, perish the instant that they drop upon the water, but the next generation are at the very same time alive and playful in that element, and ever as the warmth of a new morning returns, a fresh race cast off their finny garments, soar and sport, and often commit their progeny to the water and expire before they have even felt the beams of the sun.

Q. Then the care of the insects for their young is all prospective?

A. Yes, but it is a preparation for that of which they cannot possibly have any knowledge, and yet it is more ingenious than the larger animals can do for all their long life, or than man can do, although the experience of six thousand years be written in the volume of his book. It therefore puts wisdom and knowledge, in our view of them, out of the question, and when we study it aright, impresses us more forcibly with the Almighty power of God, than when we contemplate the revolutions of planets and the motions of systems.

Q. What does the little insect do for that future offspring which she is never to see?

A. The enumeration of even half that she does in the different species would fill volumes; but, though it very seldom has any reference to her own habits or mode of existence, she never fails to place her eggs in the very situation which is the most favourable to their preservation, their hatching and the food of the young when they become alive.

Q. Mention one or two of the cases?

A. She builds houses of wax, of wood, or of stone, cementing them with a mortar formed by her own body; she glues her eggs round twigs in such a manner as that they can hardly be torn off till the young are hatched; she excavates mines in the earth, in timber, and in stone; she drills holes in leaves, bark, and wood, in the bodies of living animals, and even in the eggs of other insects; she places her eggs upon the hides of horses and other quadrupeds, and then tickles the place so that they may lick them into their stomachs where they are protected and hatched; she builds boats and launches them upon the water; and in fact there cannot be an operation named as practicable by man, that is not out-done, both in the ingenuity of the present operation and the certainty of the future result, by some of the insect tribes.

SECTION V.—CHANGES OF INSECTS.

Q. What are the changes which an insect undergoes?

A. They are usually three besides the egg. 1. The *larva;* 2. the *pupa;* and 3. the *imago*, or perfect insect.

Q. What is the meaning of *larva?*

A. The literal meaning is a mask, and the name is applied because the future animal is concealed in the larva as in a mask. Larvæ are in common language called grubs and caterpillars, and sometimes worms.

Q. What is the meaning of *pupa?*

A. It literally means a flame, or the flame of a funeral pile; and when the insect is dormant and ceases to eat in that stage of its being, the case is generally in the shape of a flame, and it is a kind of temporary funeral. The pupa is also sometimes called a *chrysalis* and an *aurelia*, from its yellow or golden colour.

Q. Has it any common English name?

A. There is no common English name for a dormant pupa inclosed in a case; and those insects which are active in that stage of their being, usually get the names of caterpillars and worms, the same as the arvæ.

Q. What is the meaning of *imago?*

A. The image, the proper representation of the insect as a perfect being, which the larva and the pupa are not.

Q. Do all insects undergo these changes or transformations?

A. Some of the aptera or wingless insects, pass through their states with little alteration in their form and habits, and merely by repeated changes of their skin; all of them are equally voracious in the larva as in the imago state, and many of them are much more so; and there are very considerable differences in the pupa state to which names are given.

Q. What names?

A. When the pupas have the same form and habits as the perfect insects they are called complete, *pupæ completæ;* and when they are active, but have some parts, as the wings, only partially formed, they are called half-complete, *pupæ semicompletæ.*

Q. What is the state of the other *pupæ?*

A. They do not eat or move, but subsist on the fat that they have accumulated during the time they ate voraciously as larvæ; they are distinguished into three kinds.

Q. What is the first?

A. When they appear in a leathery pupa-case, which has sheaths for all the members of the body of the perfect insect which is to come out of it, they are called incomplete, *pupæ incompletæ.*

Q. What is the second form?

A. When they are inclosed in a single sheath, which has not parts answering to the members of the perfect insect, they are called covered or veiled, *pupæ obtectæ.*

Q. What is the third form?

A. When they are inclosed in a pupa case which changes into the skin of the image, instead of being cast off, they are said to be compressed, *pupæ coarctatæ.*

Q. Is there any ingenuity displayed by the creatures themselves in the performing of these changes?

A. The changes themselves are in a great measure to be considered as the results of causes in which the insect has no action, but the preparations for some of those states display a great deal of ingenuity.

Q. In which change is that most remarkable?

A. In the preparations for passing into the pupa or chrysalis state.

Q. And among what insects is it more remarkable?

A. It is worthy of notice in many, but perhaps the most remarkable takes place among the moths. The coverings of their bodies are more delicate than those of any of the other classes, and therefore they require more protection from the elements and from external injury when those coverings are in preparation.

Q. Of what substance do they form their protections?

A. Of various substances; but the one which they themselves furnish, and with which they perform a number of operations of different kinds, is gum or silk, of which they either make themselves entire nests or cases, which are called cocoons, or they form cases of leaves and other matter, which they bind together with the silk in threads, or glue them with it as a sort of cement.

Q. Is this silk of use to the larvæ of insects at any other time than when they are preparing to pass their pupa state?

A. It is useful upon many occasions to those caterpillars that live upon vegetable substances in the open air, as on the leaves of trees and plants.

Q. Which insects are those chiefly?

A. The lepidopterous insects, that is, the numerous families of butterflies and moths, which secure themselves both against enemies and accidents by fastening the end of a thread to the leaf or twig on which they happen to be, and dropping themselves down to a greater or less distance till they feel perfectly safe.

Q. And can they ascend again?

A. They can, with a curious wriggling motion, something like that of a sailor climbing a rope.

Q. How do they prepare their rope?

A. In order to understand that clearly it is necessary to know something of the structure of a caterpillar.

Q. Well, mention some of the particulars?

A. With the shape every body is familiar, but every body may not have observed that though the moth or butterfly has no mouth, but a sucker, the caterpillar has mandibles adapted for cutting and gnawing that on which it lives?

Q. What further?

A. That the first three rings from the head comprise what is to be the head and trunk of the perfect insect, and that to these there are attached six legs, each terminating in a claw, with which the caterpillar can lay hold.

Q. What further?

A. That the remaining part of the body, which is generally by far the larger part of it, answers to the abdomen of the future animal, and to this part there are attached protuberances which have not the proper motions of legs, nor do they end in claws. They are suckers, and the caterpillar can either make use of them in drawing forward its body something in the manner that sailors call "warping," or it can attach itself to surfaces on which the claws could not take hold. By this means it can walk with its back undermost, or extend the greater part of its body forward towards one object, while it adheres by the suckers, or *prolegs*, to another.

Q. Why are they called *prolegs*?

A. Substitutes for legs. The name is both clumsy and absurd, but it has been used, and to alter it would be inconvenient.

Q. But as to the silk?

A. There are inside the caterpillar two bags or vessels, often very much curved and convoluted, and increasing in size as the habits of the insect may require a greater quantity of silk. These are fastened to the intestines by two small tubes near the extremity of the insect, and expanding to a wider diameter near the middle, they again contract as they approach the head, and they unite in one orifice under the *labium*?

Q. What do these vessels contain?

A. They contain a fluid gum of a very viscid consistency, which has the property of consolidating, yet remaining very flexible when it is exposed in a small quantity to the action of the air. When they press the orifice against any surface it adheres, and when they find that it does so, they let their bodies drop, and the weight draws out a thread from the vessels which consolidates in the air, and the body hangs suspended until the danger be over, and then it can ascend by the thread.

Q. That is a singular means of safety?

A. When one examines it narrowly it is a little more singular than it even appears. The thread is drawn out by the weight of the insect, but it must be also strong in proportion to that weight, and consequently the regulating of the spinning orifice to the *staple* which the weight of the body requires, is a very nice problem in mechanics, and yet it is instantly solved by these caterpillars.

Q. Do they make any other use of these silken threads in their usual economy?

A. When they come to a surface which is so smooth that they cannot easily climb it in the usual manner, they can construct a sort of scaling ladders by making cross threads fastened at both ends, on which they raise themselves by their claws, and as they hang by one of these threads they place another higher up, and thus continue till they reach the top.

Q. Are caterpillars very voracious?

A. They are very much so, and considering the difference of size their voracity bears some proportion to the quantity of silk, not for the casualties to which they may be exposed, but for their final abode ere they come forth in the winged state.

Q. Do not they undergo several partial changes even while in the state of caterpillars or larvæ?

A. They do. They cast their skins three or four times in the course of their growth, and as they become partially inactive during these changes, they naturally seek retreats where they fasten themselves by their silken threads till they again revive.

Q. Which is the most remarkable British species that spins silk?

A. Perhaps the emperor moth, *(Phalæna attacus,)* the caterpillar of which is smooth, and feeds upon the leaves of wild apples, willows, and other trees, is one of the most laborious British spinners.

Q. What is the form of its cocoon?

A. Spread something in the shape of a fan, fastened to bays in hedges and coppices, and having an opening or chimney at the upper end.

Q. What is the consistence of its nest?

A. Something like paper, only more fibrous and tough, and covered with a varnish which cannot easily be wetted.

Q. But does not the wet find entrance at the chimney in the upper part?

A. To prevent that, the caterpillar, before it becomes dormant, constructs an inverted capsule inside the opening, which completely prevents any rain that may enter from touching it; and the fringy silk at the aperture of the cocoon partly answers the same purpose.

Q. Can the cocoon of the emperor moth be used as silk?

A. It is doubtful whether it could be unwound like that of the silk-worm; but it might perhaps be carded and spun, like the refuse of silk. The numbers in this country are, however, too few for making the experiment.

Q. Is the cocoon of the silk-worm spun in the same manner?

A. No. After the light covering of *floss* silk on the outside, the great bulk of the cocoon is in one continuous thread, and therefore they do not need to be spun, but merely twisted together.

Q. What quantity of silk may there be in the cocoon of one caterpillar?

A. Three hundred yards in length, of a double thread, is about the average.

Q. What is the weight?

A. About two thousand cocoons to a pound.

Q. Then, how many silk-worms are required for the annual supply of Britain?

A. At least two thousand millions.

Q. Could the supply be obtained in whole or in part in this country?

A. It could not be profitably obtained.

Q. Is that because the mulberry leaves, on which silk worms are fed, could not be obtained in sufficient quantity?

A. No: silk-worms eat the leaves of lettuce and several other plants; but the silk would not, in Britain, pay the cost of labour.

Q. Is that much to be regretted, as silk is so valuable a commodity?

A. Certainly not. Silk is one of the most convenient substances to transport from place to place, as its bulk and weight are so small in respect to its value.

Q. Do all larvæ spin cocoons for themselves?

A. They do not. The caterpillars of the butterflies suspend themselves by the tails, and their covering changes into the pupa-case.

Q. Do the different changes or transformations of insects take up nearly the same time?

A. The times are very various. Some take only a few weeks, or even a few days, and others several years.

Q. What are the situations of those that take up the longest time?

A. They are generally in the ground or in the water, though some of those that eat deep into dry timber also continue there for a considerable time.

PART II.

Classification of Insects.

Q. Into how many orders are insects divided?

A. It has been already mentioned that the Linnæan division was into seven orders; but later entomologists have found it advisable to subdivide some of these orders, so as to make altogether eleven.

Q. What are the names of these eleven orders?

A. They are—

1. *Coleoptera.*
2. *Sterpseptera.*
3. *Dermoptera.*
4. *Orthoptera*
5. *Hemiptera.*
6. *Trichoptera.*
7. *Lepidoptera.*
8. *Neuroptera.*
9. *Hymenoptera.*
10. *Diptera.*
11. *Aptera.*

Order I.—Coleopterous Insects.

Q. Will you repeat the character of the coleoptera?

A. The integuments of the body, and the elytra, or covers of the wings, of a horny consistency, often as hard as bone, and the hardness of the elytra in general corresponding with that of the rest of the covering.

Q. Are the elytra always of the same form?

A. They are always concave on the under, and convex on the upper side. They are sometimes detached, and sometimes soldered into one; sometimes, too, they form a shield for the whole abdomen, and sometimes only for a part of it.

Q. What is the character of the wings?

A. The wings, or under-wings, as they are generally styled, are always membranous, fortified by corneous ribs that form a sort of net-work. Sometimes they are large, and support the animal during long flights; and sometimes they are so imperfectly developed, that it cannot fly at all.

Q. How are the elytra disposed of, so as to be out of the way of the flying wings?

A. They are erected, so as to stand nearly perpendicular; so that the coleoptera make a more bulky appearance when flying than when they are at rest; and they fly with great difficulty either against or across the wind.

Q. What are the characters of the eyes?

A. They have one simple eye, or *ocelli*, on the top of the head, and one compound eye upon each side; but these are sometimes so divided, that each has the appearance of two.

Q. What is the character of their mouths?

A. Always fitted for cutting and gnawing; but as some are carnivorous, and others not, there are considerable differences in their digestive organs.

Q. What is their mode of reproduction?

A. They are all oviparous. The larvæ are found in the ground, under stones, and among rubbish. They are generally composed of twelve or thirteen rings, have scaly heads, and the organs of mastication not unlike those of the complete insect; but they are often without eyes or antennæ.

Q. Are the larvæ of the coleoptera very destructive?

A. Many of them are exceedingly so to the roots of grasses and other vegetables, which they sometimes entirely destroy.

Q. Do they remain long in the state of larvæ?

A. Many of them for several years. When they are to undergo their final change, they do not spin cocoons, but generally are buried, when they are changed into *pupæ obtectæ*.

Q. Are they long-lived in their perfect state?

A. They are longer lived than most other insects.

Q. Are they numerous?

A. Very much so. There are about three hundred and thirty-three genera, and in some of those there are many species.

Q. And they are all popularly called *beetles*?

A. Yes, that is the common English name of the whole race.

Q. Are there any characters by means of which so numerous an order can be subdivided?

A. Yes, the number of joints in the *tarsi*,* the form of the *palpi*, and also of the *antennæ*.

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* See M. Geoffroy's "Histoire abrégé des Insectes."

Q. Are these always natural divisions; that is, do they form an index to the general habits of the insect?

A. Not always; but they do in many cases, and they are obvious and simple.

Q. What are the divisions founded on the number of joints in the *tarsus*?

A. There are five tribes founded upon this character.

1. *Pentamera*, or those that have five joints to the tarsi of all the legs; but to this there are some exceptions.
2. *Heteromera*, with five joints in the tarsi of the fore and mid legs, and four in those of the hind ones.
3. *Tetramera*, with four joints in the tarsi of all the legs.
4. *Trimera*, with all the tarsi three-jointed.
5. *Dimera*, with the tarsi two-jointed.

Q. Do any of these admit of larger subdivisions than into genera?

A. The pentamera admit of a division into six families, and some of them can be further subdivided.

Q. Which is the first family?

A. *Carnivora*, or, as the name implies, beetles of prey; which are again divided into *terrestria*, or inhabitants of the land; and *aquatica*, or inhabitants of the water.

Q. What are the general characters of the carnivora?

A. They have six palpi; two upon the labium, and four upon the maxillæ; and they are the only insects that have them so. Their maxillæ are strongly hooked; and beset on the insides with bristles or spines. Both insects and larvæ are carnivorous, and the last consist of trachæ ring, the head and tail-ray scaly.

Q. What are the characters of the land-beetles?

A. They have the feet formed for walking, strong mandibles, oblong bodies, and prominent eyes: they have also two vessicles on the hinder part of their bodies, that secret an acrid liquor.

Q. What are the principle divisions of carnivorous land coleoptera?

A. There are two of them. *Cicendeliadæ*, and *carabidæ*.

Q. What are the distinguishing characters of the *cicendeliadæ*?

A. Their mandibles are prominent and toothed; their maxillæ have each a toothed claw, and the length and breadth of the thorax are nearly the same.

Q. Are they numerous?

A. There are only three genera, which are all very active and voracious insects, and some of them very beautiful in their colours.

Q. What places do they inhabit?

A. Generally dry and sandy places, in which the arvæ of some of the species make pit-falls, in which they lie with their mandibles extended, ready to seize any insect that may lose its balance on the sand which they have loosened.

Q. Which is the most remarkable European species?

A. Perhaps the field species, (*Cicindela Campestris,*)

A. They use their wings in the air, through which they fly, from one pool to another in the summer evenings.

Q. Then they have three kinds of motion?

A. They have four. They burrow in the mud, run on the bottom, swim in the water, and fly in the air.

Q. What is the second division of the pentamera?

A. *Microptera* (small winged). They are long and narrow, and the elytra do not half cover the abdomen. They live chiefly upon putrid substances, and sometimes are called dung beetles. When enraged, they elevate both ends and look very fierce.

Q. Do they sting?

A. No coleopterous insects have stings, but many of them prick and bite, and their bites are often, on account of their toothed mandibles, very painful for their size.

Q. What is the third division?

A. *Serricornua* (toothed antennæ). They are very numerous, and some of them are soft and membranous. Many of them are beautifully coloured, and some are two inches and a half in length.

Q. Which is the fourth division?

A. *Clavicornua* (club-horned). They feed on maggots and dead substances; and some of them are very destructive of furs and prepared animals. Others, when they find mice, moles, or other small animals dead on the ground, dig under and bury them, and then eat them at their leisure.

Q. What is the fifth division?

A. *Palpicornua* (having the antennæ no larger than which almost rival diamonds in the brilliancy of their lustre.

All the genera of this family have elytra, but many of them have no wings and are incapable of flight.

Q. Are any of those (*Trimerida*) that have three joints in the tarsi of importance?

A. Yes, one (the seven spotted *coccinella* or lady-bird), is very common in gardens, where it is very active in clearing plants of aphides and other small insects.

Q. Is there any thing particular in those that have only two joints in the tarsi?

A. There are only two genera of them, and they present nothing remarkable.

ORDER II.—STERPSEPTEROUS INSECTS.

Q. What are the characters of these?

A. The body is horny, wings folding, leather-like, and not covered by the elytra, which appear fixed to the coxæ of the hind legs; the mouth with mandibles, but destitute of maxillæ, labrum and labium.

Q. Are there many genera of them?

A. There are not very many, and their habits are not perfectly known. The absence of a regular mouth without the substitution of a sucker, is a curious character; and from this they are understood to be very short lived in their imago state.

ORDER III.—DERMAPTEROUS INSECTS.

Q. What are the characters of these?

A. The elytra are much shorter than the abdomen, but the wings when at rest, fold both in length and crosswise; they have toothed mandibles and a sort of helmet upon the maxillæ. They all terminate backwards in a horny fork, or pair of forceps.

Q. Are there many genera?

A. The common earwig (*Forficula*), and a larger, and also a smaller genus.

Q. Does the earwig creep into the ears of people?

A. Certainly not; though it takes up its habitation in holes and sheltered places.

ORDER IV.—ORTHOPTEROUS INSECTS.

Q What are the characters of the orthoptera?

A. The name imports that they have straight wings, that is, have the wings when expanded for flying at right angles to the line of the body. The wings fold and unfold like a fan, and the ribs are united by cross fibres, which gives to the membranous parts the same arrangement as that of bricks in a wall. Their mouths resemble the coleoptera, only they have horny shields upon the maxillæ.

Q. Is there any thing remarkable about this order?

A. It contains some of the most curious and some of the most destructive insects in the whole class.

Q. Which are some of the most curious?

A. In shape the *Mantides* are. They are generally of a green colour, and have got the name of "walking leaves." They have the wings so folded on the back that they have something the appearance of the veins of a leaf; while the thorax is so long and slender that it resembles a leaf-stalk: some of them elevate the head, thorax, and two fore-legs, in so singular a man-ing insects.

Q. Are they peaceable insects?

A. They are so much the reverse that the Chinese, and some other of the eastern nations, keep them in boxes, and make them fight, betting upon the issue; and the vanquished is instantly eaten by the victor.

Q. Which are some other remarkable species?

A. The locust (*Gryllus*), of which the migratory kind occurs in such numbers as to convert a fertile country instantly into a desart.

Q. Have they ever appeared in Britain?

A. Very seldom in any numbers, and when that has been the case, they have generally died before they did much mischief.

Q. Which are some of the other singular genera?

A. The crickets and grasshoppers, which are so remarkable for the chirping noise that they make by rubbing the elytra against each other.

Q. Is there any thing remarkable in the structure of the grasshopper?

A. The hinder legs are twice as long as the body, and they are so constructed that the insect can jump to a great distance without using the wings.

Q. Are they common in Britain?

A. The green grasshopper (*Locusta Viridissima*) is very common in all parts of the country.

Q. How many crickets are there?

A. There are three to which the name is given, of which the house cricket takes up its residence near fires, and keeps up a chirping noise in the evenings. It produces its noise by rubbing the elytra together;

A. There is a genus, *blatta*, the cock-roach, which resembles the house cricket in some of its habits.

Q. Do they belong to the *orthopterous* insects?

A. The more accurate entomologists form them into a distinct order, *dicteroptera*, or *net-winged*, because the elytra are leather-like, and marked with a network of nervures or ribs.

Q. Are there many genera?

A. There is only one genus, the species of which are, like those of the locusts, very confused.

Q. Are any of them natives of Britain?

A. None originally; but there is one which has been imported, and which infects many houses and cellars under the name of the "black beetle." They come abroad at night in immense swarms; and when they have once infected any place, they are very difficult to be got rid of.

ORDER V.—HEMIPTEROUS INSECTS.

Q. What are their general characters: have they only half-wings as the name imports?

A. They have great differences in the wings, some have the elytra horny at the base and membranous at the extremity; some have them all horny; others all membranous; in some the males only have wings; and there are some in which both sexes are without wings.

Q. What are their other characters?

A. They have *ocelli* or simple eyes; the elytra lap across each other on the back, and the segment that bears the feet is larger than the following one.

it falls; but it is greedily eaten by ants, and all other insects that are fond of honey.

Q. Is it never produced but by aphides?

A. All aphides do not produce it; but it is never produced in any other way.

Q. Which are some of the water insects of this order?

A. The boat flies and the water scorpions, the former are often found on the surface, where they swim, with their legs extended like oars; the latter live mostly at the bottom of stagnant waters and catch small insects with their mandibles, the extremities of which are formed something like the claws of crabs.

Q. Are there any curious insects in the order?

A. Some of them are remarkable for the light that they emit. They do so of course only at night; but in some of the warmer parts of the world they are so numerous, and so brilliant, that when a tree is shaken a shower of fire seems to fall from it.

Q. Which is the most remarkable one?

A. The *Fulgora Lanternaria*, which is found in the damp and woody places of tropical America; and emits so much light that one can see to read by it. There is a smaller species in the east.

Q. Are there any in Europe?

A. There are insects that have all the other characters of the genus, but they do not shine.

Q. Are there any valuable insects in this order?

A. There are. Some of the aphides furnish beauwait to catch other insects. They are on this account called "case-worms," or "caddis-worms." They form excellent bait for trout.

Q. Do they shew much ingenuity in the management of their houses?

A. A very great deal. If too heavy, they glue a float to them; if too light, a sinker. They moor them in streams, cut them adrift, and manage them with a very great deal of ingenuity.

Q. What is the appearance of the larva?

A. It has twelve rings. The three next the head horny, and the extremity ending in claws, whilst the part exposed is in armour. The pupa inhabits the same case, and has the feet so free that it can move. When it is to change to the fly state, it climbs up some aquatic plant, escapes from both house and pupa-skin, and becomes an inhabitant of the air.

Q. Where do the perfect insects inhabit?

A. Trees and plants by the banks of rivers, and the air over streams, where every breeze shakes thousands of them upon the water. They are eagerly eaten by fish, and the artificial flies of anglers are generally imitations of them.

ORDER VII.—LEPIDOPTEROUS INSECTS.

Q. What are the characters of that order?

A. The general characters are, four wings covered with scales, and the proboscis thread-shaped; and when not in use, coiled up in a spiral. They all change into pupa oblectæ.

Q. Are they very numerous?

A. They are very much so; but Linnæus compre-

3. *Laria.* Upper-wings completel There are more than twenty spe beautiful.

4. *Tinea,* of which the caterpillars to woollen stuffs.

Q. Of what insect are those cat times strip the fruit-trees and hedge the larva?

A. Of moths of different kinds.

ORDER VIII.—NEUROPTER

Q. What is the general characte

A. They have four wings, the which is generally so transparent t ribs only is visible. The under-w longer than the upper ones; the are united. There are two large c two or three ocillæ; and the par generally distinct, and adapted for

Q. What are the principal divisi

A. *Libellulidæ,* or dragon-flies day-flies; *myrmileonidæ,* or ant-li white ants, with a number of other

Q. What are the characters of th

A. They are large; have the beat the bushes, where moths live, day, and make prey of the moth.

Q. What are the characters of th

A. They are in general small; th least, and sometimes wanting, an perfectly formed.

Q. What are the characters of t

in shape; and the larva construct traps in the sand in the shape of little conical cups, in which they catch ants and other insects.

Q. What are the general characters of the *termitidiæ?*

A. They live in large societies; some species build nests many feet in height; and others form their nests on trees, and construct covered passages from tree to tree, and up the trunks and branches of trees.

Q. Are they destructive?

A. Many of them are. In the warm countries they consume everything but metal and hard stone. The whole timber of a house is often reduced to powder by them, without any external appearance of injury. The habits of many of the species resemble those of the social ants, and for that reason they are called white ants.

Q. Are there any other singular genera in the order?

A. One (*Atropos*), the death-watch, inhabits old books, and timber that is dry and dusty, and often makes a ticking noise with its mandibles, similar to the beating of a watch.

ORDER IX.—HYMENOPTERA.

Q. What are the general characters of that order?

A. They have two wings of a thin membrane, but not transparent, and the ribs fewer and less conspicuous than those in the last order. The labium and ndibles are generally fitted for cutting, and the size.

Q. What are the general characters of the *aculeata?*

A. The females have no ovipositors, but they have stings. In many of the tribes there are neuters, as well as males and females.

Q. Which are the tribes?

A. Ants, wasps, bees, spheges, and others, the genera and characters of which are exceedingly numerous. Some of them live solitary, some in societies. Some build in wax, some in mud, and some in chips of wood. Most of the females and the neuters, in the social genera, have poisoned stings. The spheges, in their winged state, live upon the nectar of flowers; but they kill, or at least wound other insects with their stings, and deposit their eggs in them, where the larvæ are hatched, and live upon the body, which is sometimes kept alive till almost all the juice of it be eaten.

Order X.—Dipterous Insects.

Q. What is their character?

A. They have only two wings, and in a few instances none. The mouth in all is a sucker, and in some it is also a piercer. Many of them suck blood.

Q. What is the principal division?

A. Into those that have a proboscis, and those that have not.

Q. What are the characters of these latter?

A. They vary, but the most remarkable character is like little sacks, into a boat, so neatly constructed that it can bear being blown about by the wind without upsetting or sinking.

Q. And where does she rest while forming her boat?

A. Upon a floating leaf or bit of grass. She works behind her, and consequently does not see the progress of her work.

Q. Does not that make her commit blunders?

A. No. The structure is always perfect; and it is remarkable that all those insects which work in the dark, do all their operations just as neatly as if they were done in the light.

Q. And how are those eggs hatched?

A. They are hatched by the heat of the weather; and when the little ones come out, they remain in the water until they change to the imago or perfect state.

Q. Do they live long after they have changed to that state?

A. Their lives are very short; and it is not ascertained that they in general eat any food; they merely play about.

Q. Do not they suck blood?

A. The females do; but for what purpose is not very well ascertained.

Q. You mentioned the *œstrides*—have they any English name?

A. They are called "gad-flies," from the annoyance that they give to domestic animals.

Q. Are there more than one species of gad-fly?

A. There are three.

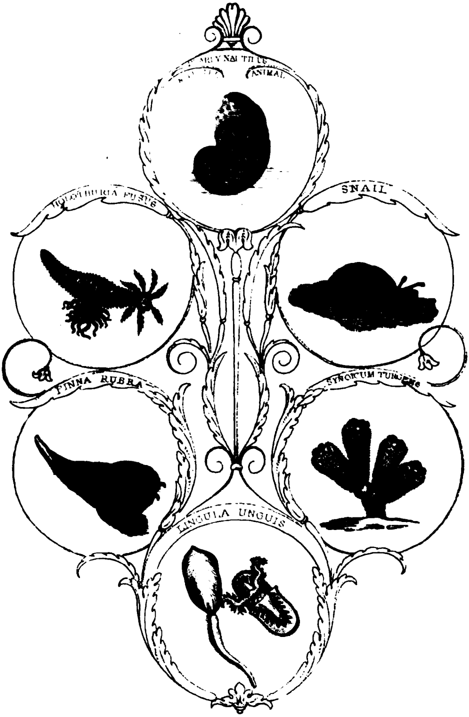
1. *Lepismida*, remarkably swift little creatures, of a silvery colour, that run about among books, cloth, &c., chiefly seen at night.
2. *Forbicinida*, which have the middle bristle of the tail larger, and the back arched for hopping. Many of them are found on the shores.
3. *Podiocellida*, with the tail turned in under the body. Found under stones.

Q. Which are the parasitical ones?

A. They are *Pediculidæ*, which inhabit the bodies of human beings, and *Nirmidæ*, which inhabit those of other animals. They are in general known by the name of lice; and the species are innumerable, as all tribes of animals, down to insects, have them.

THE END.

LONDON:
HENRY BAYLIS, JOHNSON'S-COURT, FLEET-STREET.


PEARLY NAUTILUS
ANIMAL
HOLOTHURIA FUSUS
SNAIL
PINNA RUBRA
SYNOICUM TURGENS
LINGULA UNGUIS

CATECHISM OF ZOOLOGY.

PART VI.

MOLLUSCA.

INTRODUCTION.

Q. To what class of animals is the term *mollusca* applied?

A. The animals to which the term applies are very numerous, and very varied, and thus they form several classes and sub-classes.

Q. But have they no general characters by which they may be known from other animals?

A. They have. They are all soft animals, having no natural bony skeleton, like the mammalia, birds, reptiles, and fishes; they are not divided into segments, like insects; they are not made up of rings, like earth-worms and leeches, nor do they radiate from centres, like star-fish, and some others.

Q. Where do they inhabit?

A. All places. They are found on the earth, in fresh waters, and in the sea.

Q. Are they equally abundant in all latitudes?

A. No. Animal life, in all its departments, is most abundant and most varied in the warm latitudes.

Q. Has not a particular name been given to the natural history of this division of animated beings?

A. One portion of their history has been called CONCHOLOGY, that is, the knowledge of shells; but that is not the description of the animals, but of the houses which many of them have the power of making for their habitation and defence.

Q. Then some of the mollusca inhabit shells?

A. Yes. All animals that are covered with shells, properly so called, belong to the mollusca; but there are also many molluscous animals that have no shells; and there are some that have horny or bony plates, and even shells, under the skin.

Q. Are all animals that have shelly coverings mollusca?

A. No. Many animals, as tortoises, crabs, and lobsters, have crusts that are called shells; but the mollusca have distinct shells.

Q. What do you mean by distinct shells?

A. Shells to which the inhabitant is only partially fastened, and which do not support the muscles of the animal, as is the case with crusts.

Q. Can the shelled mollusca leave their shells, then?

A. Most of those that inhabit single shells, or, as they are called, *univalves*,* have the power of leaving the shell, or retiring into it at their pleasure, only the connection between the animal and the shell is never broken; and when the animal moves, it carries its house or shell on its back, or drags it after it.

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* The term is by no means a correct one, as the majority of those shells are not *valves*, or things that open and shut, in any sense of the word.

Q. What are the principal divisions of the natural history of the mollusca?

A. They are two—the structure, habits, and uses of the whole considered generally; and the classification and description of the orders, genera, and species.

PART I.

STRUCTURE, HABITS, AND USES OF THE MOLLUSCA.

SECTION I.—GENERAL FORM.

Q. What is the general form of the mollusca?

A. They vary so much that that cannot be very well defined.

Q. Which are some of the distinctions?

A. Some have no appearance either of head or foot, but have the organs of the body inclosed in a bag, in which there appear only some holes, through which the feeding and breathing are carried on.

Q. They are not all in that form?

A. No. There are many of them very simple in their general shape, that have the covering of the body stretched out into protuberances, or *tentacula*, (vulgarly called horns,) and also a foot, for the purposes of rest or motion.

Q. Only one foot for motion; what is it like?

A. The foot of the mollusca differs very much from that of those animals that have either an internal skeleton for supporting the muscles, or an external hard crust, answering the same purpose. Having no joints, it is not adapted for stepping.

Q. How then does it act?

A. It is a sort of sucker, or rather a number of little suckers, the fore part of which keeps hold, while the animal, by contracting the length of its body, draws forward the hinder part, and then the hinder part holds on while the animal extends its body, and takes an advanced hold with the fore part of the foot.

Q. Then the mollusca do not walk?

A. No; they creep or crawl, as may be seen in the common slug or snail, the latter with his house on his back.

Q. Have they any means of assisting themselves in their motion upon this single foot?

A. Many of the land ones have the power of throwing out a glutinous kind of slime, which assists them in crawling; and in some that is so tough that they can spin it into threads, and suspend themselves from twigs or branches of trees.

Q. Is the foot common to the whole of the mollusca?

A. It is not. Some have no organs of rest, or motion but in water, and others have long tentacula, or arms, with suckers upon these.

Q. Have all the mollusca heads?

A. Some of them have, but many are without, and where there is a head, that does not contain the brain and organs of the senses, as in the animals that have skeletons.

Q. How are the tentacula and other members of the mollusca arranged?

A. Sometimes regularly in pairs, on the opposite sides of the animal, and sometimes not. There is no uniform mode of arrangement.

SECTION II.—COVERING OF THE MOLLUSCA.

Q. With what are the mollusca covered?

A. They are uniformly covered with skin, the outer skin or cuticle being very distinct, and thick and strong in those parts that are exposed, but very fine and delicate in those that are not.

Q. Has the skin any organs of motion?

A. It has, in many of the species, a very distinct muscular web, by the action of which the progressive motion, and also the changes of figure in the animal, are very much assisted.

Q. Is the skin defended by any appendage, such as the hair of the mammalia, or the feathers of birds?

A. Almost the only distributed appendage to the skin of the mollusca is hair, which is found both on land and on water varieties, and sometimes those hairs form a sort of continuous ridge of crust.

Q. Why do you say "distributed" appendage?

A. Because there are other appendages which, though some of them permanently, and all of them at times, cover the whole body of the animal, are not appendages to the skin, but fastened to the internal part of the animal by muscles.

Q. What are those appendages?

A. They are—

SHELLS.

Q. What do you mean by a shell?

A. A hard animal substance, the strengthening part of which is composed of carbonate of lime, the same substance as marble, or limestone, but more free from the admixture of other earths.

Q. How does shell differ from bone?

A. Bone is composed of phosphate of lime, and shell of carbonate.

Q. Does a shell differ also from a crust—the shell of an oyster or a limpet from the crust of a crab or lobster?

A. It does. The crust contains phosphate of lime, as well as carbonate, and thus is intermediate between shell and bone.

Q. Are there many kinds of shells?

A. There are many forms, sizes, and colours; but there are two kinds that are distinct in their structure.

Q. What are these?

A. The one kind are usually called *porcelain* shells, and the other *pearl*, or *mother-of-pearl* shells.

Q. Why are the first kind called porcelain shells?

A. Because in the fineness of their polish, the hardness of their texture, and the appearance of their fracture when broken, they have a considerable resemblance to porcelain or china-ware.

Q. Of what are they composed?

A. Wholly of carbonate of lime, only that is cemented together by a very small portion of animal gelatine.

Q. What effect does the fire produce on a porcelain shell?

A. If carefully heated to redness, and continued at that temperature for some time, it loses its gloss and its colour, and becomes of a dull greyish white, but the shape is not altered.

Q. How do you account for that?

A. The colours, depending on volatile substances, are burnt off; the carbonate of lime is changed to quick-lime, and the gelatine to charcoal, which latter gives the greyish tinge. If continued in the fire till the whole of the charcoal were burnt out, the shell would be perfectly white.

Q. Is there any thing further particular about those shells?

A. They are not generally, even in the living state, covered by a scarf-skin or epidermis; and there is no appearance of their being formed of successive plates or layers of matter.

Q. What do you mean by the living state of a shell, a shell does not feel?

A. Life and feeling are different matters. Hair, nails, and all the other insensible appendages to animals, do not, in themselves, feel any more than a shell does; but they have their living and dead states notwithstanding.

Q. What are those states?

A. So long as the shell is in connection with a livin animal, the shell is alive; that is, the animal has power of preserving and repairing it; but when it is separated from the living animal, it is acted on by the air or the water, and loses some of its freshness and beauty.

Q. What kind of shells are most capable of resisting this action?

A. The porcelain shells, because they have not the protection of a cuticle or scarf-skin, when alive, and because they have a uniform structure, and no layers or plates, between which air or any other decomposing substance can penetrate.

Q. What is the character of the pearl, or mother-of-pearl shells?

A. Externally they have not the same fine gloss and polish as the others. They often exhibit fine colours when alive; but after they are dead, the outside must be polished before the colours become visible.

Q. Is there not something peculiar in the colours?

A. Yes; the play of different colours which they exhibit, and which is in many of them very bright and beautiful, is the circumstance from which they get the name of pearl-shells.

Q. To what is that play of colours owing?

A. To the structure of the shell, which is composed of alternate thin plates* of carbonate of lime and animal matter, the latter chiefly coagulated albumen.

Q. Then the mother-of-pearl shells are different in their composition from the porcelain shells?

A. They are. They contain much more animal matter; so much so, that when the lime is all dissolved by an acid, the albuminous matter retains the form of the shell, just as the shape of a bone remains in the albuminous cartilage, after the lime and gelatine have been removed by acids.

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* See Catechism of Optics.

Q. And is that not the case with the porcelain shells?

A. No. When a porcelain shell is recent, it is wholly soluble in acids, which shews that the animal matter by which it is cemented together is not albumen but gelatine,* and it is in much smaller quantity.

Q. Is there much difference between the external and internal surfaces of a mother-of-pearl shell?

A. Yes; the external surface is covered by an epidermis, and often very rough, as in the case of the common oyster, but the inside is always smooth, and generally of a pearly lustre.

Q. How are the shells of the mollusca formed?

A. They are as much an original part of the animal, as any of the soft organs of its body. The animal has the shell in its minutest state, even before it comes out of the egg.

Q. How does the shell increase with the size of the animal?

A. So far as is known, the shelly matter is secreted by the *corium*, or skin of the inhabitant; and pearl bivalves are in many instances enlarged by the addition of new plates of matter to the inside, which extend further at the fore margins than the former plates; and thus as the animal gets larger, it makes the necessary addition to its house.

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* See Catechism of Chemistry.

Q. And how are the shells which are not bivalves augmented?

A. By successive additions at the mouth or opening of the shell, the junctions of which are in many instances quite visible on the outside.

Q. How are the porcelain shells enlarged?

A. The mode in which that is done is not known, as there is no trace of any addition to the shell, however large it may be, compared with others of the same species; and therefore, though the fact has not been proved by direct observation, it is by no means improbable that the porcelain shells are repeatedly thrown off, in order to make room for larger ones, during the growth of the animal, just as is the case with the crustacea.*

Q. Then it is probable that after a certain period the animals of the porcelain shells cease to increase in size?

A. It is; but their habits are obscure, and most of them are *pelagic*, or inhabit the depths of the sea, so that they are not very well known.

Q. Do shells derive any character from the situations that they inhabit?

A. They do. Land shells are all univalve, and they are of delicate structure, and soon decay, and lose their colours; fresh water shells are both univalve and bivalve, and some of them are of more firm consistence than land shells; but they have not the strength, the beauty, or the variety of sea shells.

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* See Catechism of Zoology, Part VII.

Q. Are there any fresh water porcelain shells?

A. They may all be considered as belonging to the mother-of-pearl shells.

Q. Is there any thing worthy of notice in the distribution of sea shells?

A. They may be classed into *littoral*, or those that are found on the shores, without low-water mark, or at all events in shallow water; and *pelagic*, or those that inhabit the depths of the sea, and are never found alive, or at all events in their native state, on the shores, or in shallow water.

Q. What are the differences of these?

A. The pelagic are generally, though not always, the strongest shells, and the porcelain shells chiefly belong to that class.

Q. Is there any thing worthy of remark in the forms of shells?

A. The *univalves*, consisting of one shell, and the *bivalves*, consisting of two shells, are the most obvious natural division; and they are attended with equally striking differences in the inhabitants.

Q. What are those differences?

A. The inhabitants of the univalve shells always have heads, and those of the bivalve have not.

Q. Is there any other difference?

A. The inhabitants of the univalve shells all have organs of motion. Some of them move by tentacula fixed to the head, and others, as the common snail, by a foot, which extends to a greater or less space on the belly.

Q. And have not the bivalve shells organs of motion?

A. Some of them have none, and thus remain fixed to the same spot during the whole period of their existence; but others have a foot that they can protrude between the two shells, and by means of that foot they can move.

Q. What is the chief division of the univalves?

A. Into shells that are straight, such as the limpet, and shells that are spiral, such as the periwinkle.

Q. Are there any distinctions of the spiral shells?

A. There are two, *entire* and *canaliculated*, and *dextral* and *sinistral*.

Q. What is meant by an entire shell?

A. One of which the mouth, or external opening has no groove in any part; and the canaliculated ones have always a groove in the mouth of the shell.

Q. Is that difference in the shell accompanied by any difference in the inhabitant?

A. It is. The inhabitant of the canaliculated shell has always a long breathing tube, which is contained in, and protected by the groove; and the inhabitants of shells that have no groove, never have a tube of that description.

Q. What is meant by dextral and sinistral, as applied to spiral shells?

A. The turns or whorls of the spiral are in opposite directions, and the organs of the inhabitants on the opposite sides.

Q. Explain what you mean by a dextral shell?

A. If the shell is placed on the mouth, with the summit or point towards the observer, the mouth is on the right-hand side of the pillar, or axis, round which the whorls of the shell wind; and the whorls may be traced in one continuous line, from the right to the left, all the way from the mouth to the summit.

Q. And what is a sinistral shell?

A. One in which, when placed as above stated, the mouth is on the left side of the pillar, and the direction of the whorls from left to right.

Q. What difference does that make on the organs of the inhabitant?

A. The openings are always on the side opposite to the pillar, and the heart on the side next to it, so that in the dextral shell the heart is on the left side, and in the sinistral the heart is on the right.

Q. Which form is most abundant?

A. By far the greater number are dextral.

Q. Are these characters of distinct genera?

A. They are. Shells which are either dextral or sinistral are so throughout the whole genera, and no instance occurs in which some of a genus are dextral and others sinistral.

Q. Have animals that have only one shell no means of closing the mouth of that shell, as a protection?

A. Many of them have a horny lid to the shell, which is fastened, not to the shell itself, but to the head of the inhabitant: that lid is called an *operculum*, and the shells that have it are called operculated.

Q. Among what shells is the operculum found?

A. Rarely among the land shells, more frequently among the fresh water, and very generally among the sea shells.

Q. Have the land shells no means of defending themselves from external injury?

A. Those land shells that cease to feed during the winter, and pass that season in holes, or under the earth in a torpid state, prepare a temporary covering to the mouths of their shells when they reach their winter retreats, but that covering is not connected with the animal, but merely with the shell, and it disappears when the warm weather returns.

Q. Is there any other general distinction of shells?

A. Yes; they are either *unilocular* or *multilocular*.

Q. What is meant by an unilocular shell?

A. One in which the whole shell, however it may be convoluted, or formed into a spiral, is made up of only one chamber, without any shelly partition or division.

Q. What is a multilocular shell?

A. One that has the cavity divided into different chambers by partitions, and sometimes those partitions are entire, and wholly separate the chambers, at other times they are perforated.

Q. What particular characters of the animals answer to these differences of the shells?

A. So little is known of the inhabitants of the multilocular shells, that it is not very easy to say.

Q. Is the shell to be considered as the external covering of the animal?

A. Not in all cases. The pearl shells have in ge- al an epidermis covering them; and the shells of many of the mollusca are concealed under the cloak or thick skin on the back.

SECTION III.—MUSCLES OF THE MOLLUSCA.

Q. Is there any thing very peculiar in the muscles of the mollusca?

A. Nothing further than that they have no bones upon which to act. In the naked ones they are inserted in the skin, which is sometimes thickened for their support, and some of them are fastened to the shell, but in most instances the animal can shift those fastenings to suit the different stages of its growth.

Q. What are the means of rest in the mollusca?

A. Besides the mere cessation of motion, the mollusca can remain at rest, fasten or anchor themselves, as it were, by *suction* and by *cementation.*

Q. What is the nature of the organ by which suction is performed?

A. Sometimes it is the simple soft foot, as in the case of the limpet; and at others, it is fortified on the opposite side by hard plates, as in the arms of the cuttle-fish.

Q. Is the power of adhesion by the sucker considerable?

A. Yes, very much so; as any one may find by trying to detach a limpet from a rock.

Q. What is the nature of the cementation by which the mollusca preserve themselves in a state of rest.

A. There are three kinds of it. Some species glue themselves to other substances by a sort of glary fluid; others cement themselves to the rock, as

Q. What are the divisions of the chelonian
A. They are divided into two genera, *Che*
turtles, and *Testudo* or *tortoises*.

I.—TURTLES.

Q. What are the characters of the turtles?
A. They have the feet flattened like oars, th
united, and flat nails in the margin; they a
largest of the order—some of them weigh 700
pounds; they all inhabit the sea, and feed upo
weeds and the small animals that are found
them; they come on shore to deposit their
but they walk very slowly and with difficulty.

Q. How many species of turtles are there?
A. There are at least six, that have been
tained, and there are probably one or two
though different describers have given different
to the same species; the species are—

1. *C. Mydas*, the green turtle.
2. *C. Rugosa*, the furrowed or wrinkled
which have the body of the shield chestnut, an
dges yellow, and each plate marked with three
verse black furrows.
3. *C. Caretta*, the hawks-bill turtle.
4. *C. Cepediana*, the cepedian turtle, which h
eet very thin and only one nail on each.
5. *C. Caouauna*, the Mediterranean or logger
urtle.
6. *C. Coriacea*, the leather-coated turtle.

Q. Of what seas are these inhabitants?
A. Of the tropical seas generally, but the

is often found in the Mediterranean, and some in the seas further to the north.

Is there any particular species to which the turtle is recommended?

Yes, it is that one the flesh and fat of which are much esteemed as articles of luxury in Europe, which are so valuable as articles of common food in the tropical parts of all the oceans—the Atlantic, Indian, and the Pacific.

Can you describe it?

A full grown green turtle is about six or seven long, from the nose to the tail, from three to four in breadth, and nearly the same in thickness at middle part of the body. The body is of an oval [illegible]. There are thirty pairs in the [illegible], which neither [illegible] nor [illegible]; they are [illegible] united by cartilage. The [illegible] of the [illegible] or flat, so that when [illegible] on its back, [illegible] and cannot turn itself; the [illegible] and short and thick, the feet long, and [illegible] two claws upon each, but [illegible] [illegible] than the [illegible] [illegible] are mentioned, [illegible] [illegible].

Why is it called the green turtle—is its [illegible] ?

No, the colour, when [illegible] [illegible] with yellow [illegible]

[illegible]

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sometimes to each other, by a preparation of lime, which hardens and keeps them constantly in the same place; and others again spin a *byssus* or thread, the one end of which is fastened to the rock or the sand, and the other to the animal, and by means of that byssus, they ride like ships anchored by a cable.

Q. What are the motions of the mollusca?

A. Opening and shutting the shells, and seizing their food, are motions common to them all; their means of locomotion are only two, creeping and swimming.

Q. How is the creeping performed?

A. By means of the foot; and it has some resemblance to the creeping of serpents, only it is much slower.

Q. How is the swimming performed?

A. In more various ways than the creeping. Some of them swim by an undulating motion of the body, like the leeches; others by the motion of the tentacula, and by other extended parts of the skin, which serve as fins.

Q. Have those that swim any air-bladder, like fishes?

A. Not exactly an air-bladder, but some species have a cellular organ which they can fill with air, or empty at their pleasure, and that answers all the purposes of an air-bladder.

Q. Can none of the mollusca fly?

A. No; but some of the bivalves have a power of leaping, or of darting down into the sand, which they accomplish by closing the shells with a sudden jerk.

Q. Are all the muscular actions of the mollusca as slow as their locomotion?

A. No. When they are apprehensive of danger, the motions of the tentacula, and some other parts of the body, are very rapid.

SECTION IV.—SENSATION OF THE MOLLUSCA.

Q. Have the mollusca a brain and nerves as organs of sensation?

A. They have a nervous system, and that system has central or communicating organs; but those organs are ganglia, or knots, rather than a brain.

Q. Is the ganglion, or knot, that answers to the brain, situated in the head?

A. No. Very many of the mollusca have no head, and in those that have, the ganglion is never situated in it.

Q. Where is the ganglion which is considered as the brain situated?

A. Over the gullet, just at the entrance into the stomach, and this sends out nerves to the mouth, and to the tentacula and eyes, in the genera that have those organs. From this principal ganglion two canals descend, one on each side the gullet, and they unite and form a second ganglion, which sends nerves to the other parts of the body In some there are small secondary ganglia after that.

Q. What is the colour of the nerves?

A. In general they are white, and enclosed in coats or tunics, and the ganglia are often of a granulated texture.

Q. Are the senses of the mollusca well defined?

A. On the contrary they are very obscure·

is doubtful if any of them have all the senses that belong to the mammalia.

Q. What sense is the most general?

A. The sense of touch, or probably "the muscular sense," and it is probable that none of them are without that.

Q. In what parts of their bodies is that sense the most conspicuous?

A. In the tentacula, and other elongations of the cuticle; and the sensibility of these seems to be, in many instances, the chief guide upon which the animal has to depend.

Q. How do they stand with regard to the sense of sight?

A. Very variably. A few have eyes constructed in a manner something similar to the eyes of other animals; some have only black points, which are believed to be eyes, rather than proved to be so; and very many have no organ whatever that can be supposed to be an eye.

Q. Which are without eyes?

A. Those that have bivalve shells generally, and some of the others.

Q. What number of eyes have the mollusca?

A. Those that have eyes have uniformly two.

Q. Where are they placed?

A. Sometimes on the points of the tentacula, and sometimes at their bases; when in the former situation it is natural to suppose that the animal has a greater range of vision.

Q. Is there any circumstance which would lead to the supposition that the mollusca depend more on some other means of sensation than on their eyes?

A. The fact that the land ones feed chiefly during the night would lead to some such conclusion.

Q. Do they depend on the sense of hearing?

A. Of their hearing little has been observed; and the cuttle-fish are the only ones that have even the rudiments of ears.

Q. Have they the sense of smell?

A. There is little doubt that many of them have both the sense of smell and the sense of taste; but in what particular organs these reside has not been determined.

Q. What extent of knowledge, or perception of the external world have the mollusca?

A. That cannot be known; but analogy leads us to suppose that it must be very limited. The knowledge of an oyster is, in all probability, confined to its shell, and to the water which brings its food, and is the element of its breathing.

Q. Then very little assistance can be obtained in the natural history of the mollusca from their organs of sensation.

A. Very little, if any, except from the absence or presence of eyes, and their situation.

SECTION V.—FOOD AND DIGESTIVE SYSTEM OF THE MOLLUSCA.

Q. On what do the mollusca feed?

A. The greater part of those that live on the land feed upon living vegetables, and many of the exceedingly destructive to the young leaves of cultivated vegetables, and to fruits; some feed upon insects and worms, others upon putrid animal matters, and the food of many of those that live in deep water is but imperfectly known, or not known at all.

Q. What are their times of feeding?

A. The land ones feed only toward and during the night, and of those that live in the water the feeding time is not known, only those that inhabit without low water mark do not feed when the tide ebbs away from them.

Q. What are their means of procuring their food?

A. The land ones, and those of the aquatic, that live upon portions of substances that are too large for being swallowed, have mouths adapted for cutting, though they are not capable of performing any operation analogous to that of chewing. Many have tentacula for seizing their prey, and conveying it to the mouth, and others have an extended lip, proboscis, or tongue, which answers the same purpose.

Q. What is the structure of the stomach?

A. In some it is very simple and membranous, and in others it bears a considerable resemblance to the gizzard of a fowl.

Q. Are they voracious?

A. Many of them are; but so far as observation has gone they are capable of bearing hunger for a great length of time. The common garden snail eats nothing from the time that the cold drives it into its winter retreat, till the heat of the next season calls it out again.

Q. Are their organs of nutrition simple or not?

A. They are much more simple than those of the higher animals. They want gall and various juices that are understood to contribute to digestion in them.

Q. What parts of the digestive system is it most important to be acquainted with?

A. The mouth and stomach, because these lead best to a knowledge of the food of the species.

SECTION VI.—CIRCULATION OF THE MOLLUSCA.

Q. Of what colour is the blood of the mollusca?

A. It is white, with a slight bluish tint, and it is cold; but its chemical composition has not been examined in a satisfactory manner.

Q. Do the veins of the mollusca perform more functions than those of some other classes of animals?

A. They do. They appear to take up the nourishment from the intestines as lacteals, and they also circulate and absorb the watery juices as lymphatics.

Q. Have all the mollusca the same kind of system of circulation?

A. No; their habits are so different that we should not expect that in theory, and in practice there are at least five different forms of circulation.

Q. What is the first form?

A. The blood which returns from all parts of the body, together with the chyle, or nourishment from the food, is taken into a large vein, from which it proceeds in two branches to the lungs or gills, according as the animal breathes air or water. The is an enlargement on each of the branches, which may be considered as a ventricle, and the course thence to the lungs or gills as arteries. From each lung or gill there proceeds a branch to a single systematic ventricle, by which the blood is sent in circulation over the body, so that, in these, the heart has three ventricles, two for aërating the blood, and one for sending it over the system.

Q. What is the second form?

A. The blood is sent directly to the lungs or gills without the aid of any thing like a heart; the blood returns from the lungs to a ventricle, and thence to an auricle, from which it is sent over the system. So that the heart of these has only two cavities, and they are both systematic. In some, however, the ventricle consists of two lobes or portions, though these make only one cavity.

Q. What is the third form?

A. It differs from the second only in having two ventricles; but they both open into the same systematic auricle. The two lobes in the ventricle of the former are an approximation to this form, and there is also some similarity in the animals.

Q. What is the fourth form?

A. The heart wholly without ventricles of any kind, but with two systematic auricles.

Q. What is the fifth form?

A. The heart consisting of a single cavity, which is a systematic ventricle.

Q. Do those different organizations belong to classes differently formed in other respects?

A. In general they do, but not always. So that no absolute conclusion can be founded upon them.

SECTION VII.—RESPIRATION OF THE MOLLUSCA.

Q. Is the mode of respiration among the mollusca uniform?

A. As some of them live on the earth, some in shallow waters, and some in the depths of the sea, and never come to the surface, their modes of respiration are necessarily very different.

Q. But they all do respire in some mode or other?

A. They do. There is no animal, how simple soever, or how little soever it may resemble those that we are accustomed to call the higher or more perfect animals, but which breathes in some manner or other.

Q. What are the different modes of breathing among the mollusca?

A. Those that breathe free air, whether they inhabit the land, or inhabit the water and come up to the surface to breathe, have lungs like the land animals and the cetaceous mammalia; and those that breathe under the water have gills like the fishes.

Q. Do you mean that the structure of those organs is the same?

A. No. Only the general mode of using them, and the elements in which they are used.

Q. Whether have the greatest number lungs or gills?

A. By far the greatest number have gills.

Q. Are the lungs simple?

A. They are very much so, there is generally only a single cavity with the pulmonary artery ramified, over the inner surface of it; and the animal can at pleasure shut or open the entrance to that cavity.

Q. What are the forms of the gills of the mollusca?

A. They are very varied. In some cases there is only a single cavity into which the water enters, and which has the gills in ridges upon the walls of it; in some there are two cavities, and in others four. In some those gills are external, and in others they are internal; some have the power of exposing them to the action of the water, or withdrawing them from that action at pleasure; and some have them constantly exposed to it.

SECTION VIII.—PRODUCTION OF THE MOLLUSCA.

Q. How are the mollusca produced?

A. From eggs, which are in general hatched externally. The land ones deposit their eggs in the earth, or under stones and rotten wood; and these that inhabit rivers often glue them to aquatic plants.

Q. Is there not something curious in the mode in which these creatures are produced?

A. Yes; it is one of the most curious subjects in natural history. Some species are males and females, and spawn like fishes; some are both male and female in every individual, and have a double progeny, and some produce from the single individual.

Q. Do these last produce their young by buds, like the hyelia, or by the division of their bodies, like the planaria ?*

A. No; they produce them as eggs, or separate beings.

Q. And is there no confusion of races in those singular modes of production ?

A. Not the least. The young of the oyster, that are the sole production of one individual, are just as perfect to the race as those of any of the warm blooded animals.

SECTION IX. – USES OF THE MOLLUSCA.

Q. Are the mollusca of much use to man ?

A. They are, both in his rude and in his cultivated state.

Q. What are their uses in the rude state of mankind ?

A. They are most important. The shelled mollusca, whether they inhabit rivers or the sea, cannot escape by flight, like fishes, or even the crustacea; and therefore they form a standard and certain article of food to those wretched people who have not learned to cultivate vegetables, or breed domestic animals.

Q. Are they still used by any people ?

A. The shelled mollusca, both of the rivers and the coasts, are very largely used by the natives of New South Wales, and by those of very many other countries. At some seasons the people may be said to live wholly upon them.

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* See Catechism of Zoology, Part VII.

Q. Have they any other use to rude nations?

A. They stand in the place of the metals. Part of a hard shell, ground to the desired shape on a stone, becomes a knife, the head of a spear, or arrow, or a fish-hook; the large bivalves serve for bowls and dishes; and the large univalves for bottles. A savage deprived of shells would be nearly in the same condition as is civilized man deprived of iron.

Q. What are their uses to civilized men?

A. They are useful as food; the shells are collected as ornaments; the coarser shells burn into very pure lime, and some of the inhabitants secrete fluids that form dyes or colours.

Q. Which of them are used as food?

A. A very considerable number of those that inhabit the sea and its shores, and in years of scarcity and famine they have often saved the lives of thousands of the poor, who must otherwise have perished for want of food.

Q. Which is the most esteemed?

A. The oyster; but it cannot be properly considered as poor man's food, as it has to be dredged out of deep water, and thus is not got without considerable expense.

Q. Is the oyster always wholesome food?

A. Always, when not itself diseased or too long kept, which is known by its being livid and discoloured.

Q. Which is next to it?

A. Perhaps the mussel, which is more generally diffused on the British shores, and more accessible, so that the children can gather it at low water.

Q. Is the mussel always wholesome?

A. In the early part of the season it is always rather suspicious, partly because it has just then spawned, and partly from feeding on the young of the star-fish, which is not wholesome.

Q. And does food that will not poison the animal that eats it, render its flesh unholesome?

A. It does. The wholesomeness and flavour of all animals are very much affected by their food. Milk from turnips is rank as compared with milk from hay; and mutton from a dry down is much more wholesome than from a marsh.

Q. Which is the next?

A. The cockle. It is found in the sand, and as it has not the same chance of eating unwholesome food as the mussel, there is less danger in it; and its flavour in the months of March, April, and May, when it is in season, is much more delicate.

Q. Are there any other eatable bivalves?

A. Yes; the razor-fish, or spout-fish (*solen*), some of the gapers (*myæ*), and the scallop (*pecten*). These are, however, used only in some parts of the country, there being prejudices against them in others.

Q. Are there any univalves used as food?

A. Yes. The periwinkle and the welk (the names are sometimes confounded). The former is by far the most delicate, and also the most plentiful on the British shores.

Q. Are any of the land mollusca used as food?

A. As they live upon fresh vegetable matter, the very choicest that they can find, it is very probable that with proper cooking, they would all make wholesome food; and some of them have been eaten in some countries ever since the days of the Romans.

Q. Are any of the animals of the shelled mollusca used for any other purpose than as human food?

A. They are of great value to the fishermen, who use them as baits in the white fishery.

Q. How are the shells of the mollusca useful as ornaments?

A. The more handsome ones are highly prized for their forms and their colours; many ornaments and little useful things are made of the mother-of-pearl shells; and when disease in the organs that fabricate the shell, cause the shelly matter to collect into a little ball within the animal, that ball is, according to its size and beauty, valued as a pearl.

Q. What species furnish pearl?

A. Many species, and some different genera of bivalves, but they will be more particularly mentioned afterwards.

Q. What shells afford lime?

A. Any shells; but the oyster is the most convenient.

Q. Are shells ever used as a manure for land?

A. They are. On many parts of the coasts, there are extensive banks formed wholly of fragments of shells that have been broken by the tides and currents of the ocean, and for some soils these form an excellent manure.

Q. What are the fluids of the mollusca that are used as colouring matters?

A. The black fluid which the cuttle-fish throws out when alarmed, is understood to be one of the ingredients in the best Indian ink; and there are some of the univalves that yield fluids that have been at times highly prized for dyeing purple.

Q. Are there more species than one that afford those dyes?

A. There are three or four species, the liquids from which have various shades of colour, and degrees of durability; but the quantity is too small, and the process by which it is obtained too tedious for modern use.

Q. Are there many persons employed in the capture of shell fish?

A. In the British islands there are more than ten thousand employed in catching them for sale, and carrying them to the different markets; and in the remote isles they form an important part of the food of a still greater number.

Q. Then the mollusca are not an unimportant part of creation?

A. No part of creation is unimportant as an object of study; and as objects of general usefulness, the mollusca rank next after the mammalia, the birds, and the fishes; while in some parts of their natural history they are more singular and curious than even these.

PART II.

CLASSIFICATION OF THE MOLLUSCA.

Q. Is the classification of this part of the animal kingdom complete?

A. Very far from it. There are various classifications, possessing different degrees of merit; but there is none of them perfect, nor is it possible to form a perfect one, in the present state of our knowledge.

Q. What is the reason?

A. There are several reasons: many shells are known, of the inhabitants of which we have no knowledge; and our knowledge of the nature and habits of many of those that are known is very limited; besides, the descriptions are often so imperfect, as not only to leave the species, but even the genera, in doubt.

Q. Which are the most natural great divisions?

A. Perhaps the following are as natural as any:—

ORDER I.—CEPHALOPODA.

Q. What is the meaning of *cephalopoda?*

A. That the feet are attached to the head, and not to the belly or body of the animal.

Q. Which is the next order?

A. ORDER II.—PTEROPODA, or wing-footed.

Q. Which is the third order?

A. ORDER III.—GASTEROPODA.

Q. What is the meaning of *gasteropoda?*

A. That the foot is attached to the belly of the animal.

Q. Which is the fourth?

A. ORDER IV.—CONCHIFERA, or those that are enclosed between two valves of shell.

Q. Which is the fifth?

A. ORDER V.—TUNICATA, or those that are covered with a leathery cloak or tunic.

Q. Which is the sixth?

A. ORDER VI.—BRACHIOPODA, or those that have two fringed feet, or arms, issuing from between the lobes of the cloak, and capable of being extended beyond the shells, or rolled up spirally within them.

Q. Are the animals equally distributed in those orders?

A. Very far from it. Some of those orders contain but a few species, or even individuals; but they have the advantage of being natural. Some of the orders have, however, to be divided into sub-orders and sections, before we come to genera and species.

ORDER I.—CEPHALOPODA.

Q. You mentioned that the cephalopoda are animals which have the feet attached to the head?

A. Yes; but those feet are rather tentacula or arms, than feet properly so called.

Q. What is their common name?

A. They are usually called cuttle-fish.

Q. What element do they inhabit?

A. They are all inhabitants of the sea, and they are swimmers.

Q. What is the form of these animals?

A. They consit of a tunic or sac, which contains the viscera, and of a head, surrounded by the arms, or tentacula.

Q. Are there different kinds of them?

A. Yes. They differ so much that they may be considered not merely as separate genera, but as sub-orders.

Q. What are their general character, or those that belong to the whole order?

A. Besides the form, which has a resemblance in them all, they spawn like fishes; they have two gills for breathing, one on each side; they have two eyes, something resembling those of the vertebrated animals, and they have the rudiments of organs of hearing.

Q. Mention some more particulars of their form?

A. They have a flattened disc on the top, in the middle of which is the mouth, which has a fold of skin resembling lips, and within that two horny mandibles, bearing some resemblance to the beak of a parrot; and the tongue, which is placed between the horny mandibles, is armed with teeth.

Q. You mentioned the tentacula, or arms?

A. These are connected with a ring of muscles that surrounds and strengthens the disc containing the mouth; they have numerous suckers on their inner surfaces, by means of which the animal can attach itself firmly to substances; they are sometimes fortified with fins of horn on the other side, and in some of the species there are two much longer than the rest, which are denominated feet.

Q. What is the use of the arms of the cephalopoda?

A. They serve many uses. The animal lays hold with them, conveys its food to its mouth, and it uses them as oars in swimming.

Q. Have they no other swimming appendages but the arms?

A. Some of them have not, but others have fin-like appendages to the sac which contains the viscera.

Q. What is the consistence of the sac?

A. In some it is wholly soft, and protected only by a thick leathery cloak, or tunic, but in others it is protected by shells.

Q. Of what forms are the shells of the cephalopoda?

A. Some are internal, and consist of spongy plates of shelly matter, improperly called cuttle-fish "bones," while others are external, and of a spiral form.

Q. Is there any thing peculiar in the stomach of the cephalopoda?

A. It is worthy of remark that the stomach resembles the gizzard of a fowl, at the same time that the mandibles resemble a beak.

Q. Are these the animals that discharge the inky fluid?

A. They are. That fluid is a peculiar secretion, the object of which appears to be to conceal the fish from its enemies by darkening the water.

Q. Of what seas are the cephalopoda inhabitants?

A. They are inhabitants of all seas from the equator to the poles; but they are much more numerous, both in individuals and in species, in the warm seas;

and they attain a much larger size there, so much so that they have been said to pull boats under the water, and also to retain divers there till they were drowned.

Q. Are there not some peculiarities in the eyes of this division of the mollusca?

A. The eyes of the cuttle-fish, in particular, are much larger and more perfect in their formation than the eyes of many other animals; and though the concave or fore part of the eye be flat, as is the case with all animals that live in the water, the cuttle-fish enjoys a considerable range of vision—can see a good way about it.

Q. How is that effected?

A. The opening of the eye-lids is considerable, and the crystalline lens, or magnifying organ of the eye, stands out so that it can receive the rays of light from a considerable portion of space.

Q. Then there is reason to believe that the animals of this order depend more on vision than many of the other mollusca?

A. There is. Their habits are but obscurely known, but as they are swimmers, and often near the surface of the water, it is highly probable that they perceive their prey by the sight, which is not the case with the night-feeders among the land mollusca, or with those that inhabit the bottom of the sea and the holes of the rocks.

Q. What is the form of the crystalline lens?

A. It is spherical, and in its texture it resembles that of the vertebrated animals.

Q. Is there no peculiarity in it?

A. There is a very remarkable one: the organ, instead of being composed of one lens, is composed of two, which are united transversely to the line of vision by a partition of the retina and its coats.

Q. And does the lens occupy the greater part of the eye?

A. It does not. The greater part is filled by a vitreous humour, which is not contained in cells like that in most other animals, but flows out where the coats of the eyes are punctured.

Q. Are there any sub-orders of the cephalopoda?

A. There are two, *Sepiacea,* in which the sac is supported by horny or shelly processes, or plates, and *Nautilacea,* in which it is furnished with a shell.

SUB-ORDER I.—*Sepiacea.*

Q. How many genera are in that sub-order?

A. There are usually reckoned five.

1. *Octopus.*
2. *Eledona.*
3. *Ocythöe.*
4. *Sepia.*
5. *Loligo.*

Q. What are the characters of *Octopus?*

A. As the name implies, they have eight arms or feet, furnished with a double row of suckers, and all of equal length. The *Octopus vulgaris,* which is found in the British seas, may be taken as the type. The body is short, the arms six times the length of the body, and furnished with not less than two hundred and forty suckers.

Q. What are the characters of *Eledona*?

A. In general like the former, only the arms have but a single row of suckers. Some of them smell like musk. They have not been met with in the British seas.

Q. What are the characters of *Ocythöe*?

A. They are singular, and some of them have been misrepresented.

Q. What are those that relate to the form of the animal?

A. Two of the arms have a membranous expansion like a sail; and the double rows of suckers upon the others are placed upon short foot-stalks.

Q. Have they shells?

A. They have never been found excepting in shells; but the shells which they are found inhabiting are not of their own construction, nor are they connected with them in any way whatever, further than by taking possession. They can leave the shell enentirely when they please, which is not the case with any of the mollusca that manufactures its own shell.

Q. What shell is it of which the Ocythöe takes possession?

A. The *argonauta*, vulgarly called the *paper nautilus*.

Q. And is not the animal that makes the shell known?

A. No. The shell has been often met with, the animal never. It belongs by analogy to the second sub-order of cephalopoda.

Q. And how does the Ocythöe manage its adopted shell?

A. With great adroitness. It rises to the surface, rows with its suckers, spreads its membranous arms as sails, and dives to the bottom when danger appears.

Q. What are the characters of the genus *Sepia?*

A. They have a narrow fin on each side of the sac; the suckers are irregularly placed, and the back of the sac is strengthened by a shelly plate, of a very light and spongy texture.

Q. Is that plate the cuttle-fish bone of the shops?

A. It is; but it has no resemblance to bone, it is chiefly carbonate of lime, and therefore a shell.

Q. Does that plate consist of uniform matter through its whole substance?

A. No. There are tubercles on the upper part of it as hard as porcelain shell, but they contain more animal matter; within those there is a layer of tough and flexible horn, and within that the successive layers that make up the body of the plate are more like pearl-shell, but they are very light, loose in their texture, and without lustre.

Q. Was not the bone of the cuttle-fish once used in medicine?

A. Yes; but it has no more medical qualities than any other carbonate of lime.

Q. Have the sepia feet?

A. They have two of the arms much larger than the rest, to which the name of feet is usually given.

Q. Where does the sepia inhabit?

A. It is not uncommon in the British seas, but as it is a pelagic animal, it is not often taken alive, the shelly plate is frequently cast upon all the shores from the south to the north of the island.

Q. What are the characters of *Loligo?*

A. The plate is horny, and imbedded in the sac, the arms and legs are not so long in proportion as those of the sepia, and the suckers are disposed in double rows. There are several species found on the shores both of Scotland and England.

Q. Are any of them used as food?

A. Formerly they were, and in some places they are so still; but they are not used in Britain.

SUB-ORDER II.—*Nautilacea.*

Q. What is the distinguishing character between these and the others?

A. They have shells, and the others have not.

Q. What are the principal genera?

A. There are principally two of them:

1. *Spirula,*
2. *Nautilus;*

but the nature of the animals is imperfectly known. Both have spiral shells, which are multilocular, that is, divided into a number of chambers or compartments, by partitions, which are entire in some cases, and in others perforated in the centre; but the shell of the spirula is internal, and that of the nautilus external.

Q. Of what seas is the *spirula* a native?

A. It is found most abundantly in the West Indian as, where one species, the *spirula vulgaris*, is very mon.

Q. What are its characters?

A. It bears a considerable resemblance to the sepia; and the spiral shell occupies nearly the same situation as what is called the "bone" in that animal.

Q. What is the use of the shell?

A. That is not very well known; but as the spirula inhabits deep water, it is by no means improbable that the animal uses it as an air-trunk, by the management of which it changes its specific gravity, and rises or sinks in the water.

Q. What are the characters of the genus *Nautilus?*

A. They are very imperfectly known. The animal of one species, the *nautilus pompilius*, has been described by Rumphius, who mentions that the animal resides in the last chamber of the shell, the one next the mouth; and that a ligament descends through the perforations in the partitions to all the other chambers. The arms or tentacula that surround the mouth of the nautilus have no suckers.

Q. What is the use of the shell?

A. The last chamber of the shell protects the animal; and it is probable that the other parts may act in changing the specific gravity, in the same manner as the internal shell of the spirula; but the general economy of those very singular animals is but little known; and, in natural history, conjectures are worse than useless.

ORDER II.—PTEROPODA.

Q. What is the meaning of *pteropoda?*

A. Literally it means "wing footed;" but as a animals to which it is applied are inhabitants of the sea, it really means "fin-footed."

Q. Are they naked animals, or have they shells?

A. Some are covered with a double tunic or cloak, some have spiral univalve shells, some have two shells soldered together at the place where the hinges are in bivalves; and some have heads, while others are without.

Q. What are the characters which are common to them all?

A. They have no feet for crawling, no suckers for adhering to substances, no arms for seizing their food, and it is doubtful whether any of them have organs of sight.

Q. What are their positive characters?

A. They are all small in size; they swim by means of two fins, one on each side of the anterior part of the body; they are continually floating in the water, and have the the power of altering their shape, size, and specific gravity; and each individual is both male and female.

Q. What seas do they inhabit?

A. They are rare in the temperate latitudes, and have never been found on the British shores; but some of them are very abundant in the warm latitudes, and others swarm in the arctic seas, where they form a considerable portion of the food of the common whale.

Q. What are the genera?

A. They are—

1. *Clio*, with a membranous covering; found both in

the warm and cold seas (different species), and having the fins and gills in the same organs.

2. *Cleodora*, of a pyramidal shape, and with two membranous wings or fins.
3. *Cymbulia*, with the tunic cartilaginous, and in the form of a trough. It has only one wing or fin, but that is divided into three lobes.
4. *Limacina*, with the hinder part of the body enclosed in a weak spiral shell of a turn and a half, and the head and fins very like those of clio. It is very abundant in the polar seas.
5. *Pneumodermon* (breathing by the skin, the gills being fin-like appendages on the neck). This genus has a soft covering, and possibly the tentacula, from their form, have suckers.
6. *Hylea*, destitute of a head, and having two valves of shell soldered together. Found in the Mediterranean.

ORDER III.—GASTEROPODA.

Q. Is that a numerous order?

A. Exceedingly numerous, and the genera which it includes are very much diversified in their appearances and habits.

Q. What are the general characters?

A. The foot on the belly, from which the order is named, is the most general one.

Q. What are the parts of the gasteropoda?

A. Independently of the particular organs, which vary with the habits of the animals, and the elements in which they live, they may all be consider-made up of the foot, the cloak, or tunic, and the head.

Q. What is the foot?

A. It is a firm, muscular organ, covering a greater or less part of the under side of the animal, according to the species. The inner surface of it supports the viscera, and the outer serves as a sucker and an organ of motion; and, in those species that inhabit the water, it answers also as a fin.

Q. What is the cloak?

A. A strong leathery covering, attached to the foot at each side, and forming an arch over it, which protects the vital parts of the animal. Sometimes the back of the tunic is supported by plates of shelly matter, and sometimes by a conical, or spiral shell.

Q. How is the head situated?

A. It is united to the foot below, and to the cloak on the sides and back. In general it is furnished with tentacula.

Q. What is the system of circulation?

A. It is very simple. There is no ventricle or auricle connected with the lungs. The heart is usually in the left side of the body; but in those that have spiral shells, the heart is always situated on the side next the pillar, round which the whorls or spires of the shell wind.

Q. What is the system of respiration?

A. There are two distinct systems: those that breathe air by lungs (*pulmonifera*), and those that breathe water by gills (*bronchifera*), and those form two sub-orders, or sub-divisions of the order.

SUB ORDER I.—GASTEROPODA PULMONIFERA.

Q. What is the general character of these?

A. They all breathe free air, and have one pulmonary cavity, on the side opposite to the heart, the opening to which they can shut and open at their pleasure.

Q. How are they produced?

A. They are all produced from eggs, and they are generally male and female in the same individual.

Q. Are all the gasteropoda that breath air with lungs inhabitants of the land?

A. No. Some of them inhabit the land, and some the water, so that they have to be arranged in two sections.

SECTION I.—TERRESTRIAL.

Q. Are there any distinctions of these?

A. Yes. There are two tribes, one that have the shell, which is sometimes flat, sometimes sub-spiral, and sometimes a flexible horny plate, imbedded in the cloak, and those that have the shell conical or spiral, and external, covered only with an epidermis, and covering the body of the animal.

Tribe 1. *The shell or shield in the cloak.*

Q. What are the general characters of these?

A. They have four tentacula, which are capa being extended or withdrawn, the eyes are black points on the tips of the upper pair.

Q. Are these animals perfect in their organization?

A. The organization of all animals is the very best adapted to their habits and the elements in which they live, that it is possible to imagine; but if we except vision, we have reason to conclude that the senses of those animals are not very acute.

Q. Have they not the sense of taste in considerable perfection?

A. They must, for we find that slugs and snails, which belong to this subdivision, find out the most delicate vegetables, such as young leaves and ripe strawberries and other fruits, with great care and certainty; and that they are not guided by the sight is plain, because their selections are generally made in the dark, and they prefer dull weather to that which is bright.

Q. Is there any part of their anatomical structure from which we can form an estimate of the general acuteness of their different senses?

A. Yes. In all organs that have been discovered and examined as the seats of particular senses, it is found to be a general law that that organ which is the most abundantly supplied with nerves is the most sentient.

Q. And how does that apply to the animals under consideration?

A. The tentacula are much more abundantly supplied with nerves than the eyes, whether the eyes be seated on the tentacula, or at their bases; and therefore, as the tentacula are the organs of touch or feeling, we are warranted in concluding that that sense is much more acute—of much more essential service to the animal than the sense of sight.

Q. How many genera are there?

A. There are three known genera:

1. *Limax*, the slug;
2. *Parmacella*, and,
3. *Testacella*.

The first genus is very common; there are many species, and they are very destructive to young plants, and to strawberries, and other esculent fruits.

Q. What are the characters of the slug?

A. The body is lengthened and pointed behind; the cloak is furrowed, and contains towards the head the shield, which is a flexible, horny plate. The whole body is lubricated with a glutinous slime, and the animal leaves a train of the same slime where it passes along.

Q. Are those animals hardy?

A. They are much more so than the shelled tribe of the same sub-order. Slugs come out of their winter habitations much earlier in the season, and they are found in those cold and upland parts of the country where no shelled ones are to be met with.

Q. What is the character of their mouths?

A. They have horny jaws for cutting; but as they feed upon succulent substances, their stomachs are very simple.

Q. Do they live wholly upon vegetables?

A. Not altogether. Some of the larger species fe-- upon earth-worms.

Q. What are the distinguishing characters of Parmacella?

A. The chief one (as the name imports) is that the shield is not toward the head, as in the slug, but at nearly equal distances from both ends of the body. There is only one known species, a native of Mesopotamia.

Q. What are the characters of testacella?

A. Besides the shield at the anterior part of the cloak, there is an open sub-spiral plate of shell farther backwards, and the foot extends on each side beyond the body.

Q. What are its habits?

A. It lives, for the most part, under ground, where it pursues and preys upon the common earth-worm.

Testacella—tribe 2. The shell external.

Q. What are the characters of these?

A. The shells are spiral, more or less turbinated, covered with a cuticle, and sometimes armed with hairs.

Q. Are they very numerous?

A. They are very much so.

Q. What is one of the most common genera?

A. The snail (*Helix*); of which there are at least twenty-two species, natives of Britain.

Q. What are the characters of the animals?

A. They very much resemble those of the slug. Snails form, during the spring, a great part of the food of the thrush tribe; and the broken shells may be found in great numbers under hedges, where the birds dig the snails from their hiding-places, and thus render a most important service to the gardener and the farmer.

Q. What are their characters?

A. In Britain, though they are very abundant in some districts, they are by no means so widely diffused as the naked slugs.

Q. What is the difference in their localities?

A. The shelled snails are confined to the warmer parts of the country, and are never found in the bleak mountainous districts; they are fond of moist weather, but they cannot live in so wet places as the naked slugs, and they perish sooner in water.

Q. Is it not rather singular that an animal covered only by a skin should be less affected by changes of heat and cold than one which is protected by a shell?

A. Not at all, the hardness, the strength, or the thickness of the covering is not that which protects the inmate from changes of temperature.

Q. And may a mere skin be a better protection against heat or cold than a hard substance?

A. It may. A flannel jacket may be, and would be a much better protection against changes of temperature than a casing of iron; and a moistened sheet of blotting paper is a much better protection against heat than the thickest garment. The moist and slimy coat of the slug, with the internal plate or shield over the vital parts of the body, is a much better protection than the shell of the snail.

Q. What sort of retiring places do the snails prefer?

A. Holes in old walls, and other places that are comparatively dry; they are very numerous in dry fields, where they nestle and spend the winter under the hedges, at a greater or less depth according to the degree of cold.

Q. Which is another important division of the tribe?

A. The *pupacea*, the shells of which have teeth, or laminæ; and at a certain age the mouth of the shell thickens into a ring, after which the shell and the inhabitant cease to grow in size.

Q. Is there any further peculiarity about them?

A. Yes; some of the shells are dextral, and others sinistral. The inhabitants of the dextral shells, have all four tentacula; but some of those of the sinistral have only two.

Q. Is there any other remarkable genus?

A. Yes. *Vitrina*, in which the shell only incloses a small portion of the body of the animal, and has the lobes of the cloak folded back over it.

Q. Any other?

A. Yes. *Cyclostoma* (round mouth), in which the mouth of the shell is circular, the foot furnished with an operculum, the eyes not on the tentacula, but on little foot-stalks at their base, and the sexes distinct.

Q. Are there any British species?

A. Yes, there are at least two, of which *cyclostoma elegans*, found under moss and ferns, is the most remarkable.

SECTION II.—AQUATIC.

Q. What are their general characters?

A. They live in shallow fresh waters, and come to the surface to breathe; they have generally two flat tentacula, with the eyes at their bases.

Q. Are they male and female?

A. No, the sexes are united in the same individual.

Q. Where do they place their eggs?

A. They glue them to the stalks of aquatic plants, with a glutinous substance that is not soluble in water.

Q. On what do they feed?

A. On vegetable matter under the water.

Q. And how do they breathe?

A. As they breathe by lungs, they have to come to the surface of the water for respiration.

Q. Have all this section shells?

A. No. Like the terrestrial ones they form two tribes, one of which has no external shelly covering, and the other has.

Tribe 1. *Naked.*

Q. What are the characters of the naked tribe?

A. Some of them are rather obscure, as few individuals have been examined. Those that have been so have had the cloak of more than usual thickness, the lungs near the hinder part of the animal, the mouth without proboscis, or jaws, and retractile tentacula, like those of the slug.

Q. Do they form many genera?

A. So far as has been observed they form only one genus, *Onchidium.*

Q. Are there any British species?

A. No. The only ones that have been met wi have been in Mauritius and India, and the Indian species is not very clearly described.*

Tribe 2. *With shells.*

Q. Are these more numerous than the former?

A. They are much more so. There are at least seven genera, and six of those are British species.

Q. What are the genera?

A. They are these:—

1. *Lymnaeus.*
2. *Physa.*
3. *Aplexa.*
4. *Conovula.*
5. *Planorbis.*
6. *Segmentina*, and
7. *Ancylus.*

Q. What are the characters of the first genus?

A. They have all dextral spiral shells, they inhabit pools, lakes, and rivers, and form part of the food of fishes and of water-fowl; they have two prominent tentacula, have three jaws, and are of both sexes. Some of them are much infected by very minute, parasitical leeches.

Q. Are there many British species?

A. There are six or seven, one of which grows to the length of two inches. It is found in stagnant waters.

Q. What are the characters of *physa*?

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* Linn. Trans. V. p. 132.

A. The shell is sinistral, about half an inch in length, glossy, and of the colour of horn. The cloak is transparent and can be reflected over the margin of the shell, as the animal moves along the surface of the water.

Q. Where does it inhabit?

A. Shallow lakes and pools, and slow running streams.

Q. What are the characters of Aplexa?

A. It is a small sinistral shell, the cloak of which does not fold back over the shell.

Q. Where is it found?

A. In slow streams; but it is rare in Britain.

Q. What is the character of *conovula?*

A. The shells are conical, but the animal is not known.

Q. What are the characters of *planorbis?*

A. The spires of the shell are nearly in the same horizontal plane, or flat. When some of the species are irritated, they give out a purple fluid from between the cloak and the foot.

Q. Are there many British species?

A. There are at least nine, most of them very minute; and all of them inhabitants of ditches and shallow pools. The tentacula are in the form of threads.

Q. What are the characters of *segmentina?*

A. The shell is divided into chambers which communicate with each other by triangular openings. The British species is very minute, and the animal resembles that of the planorbis.

Q. What is the character of *ancylus?*

A. The shell is a flattened cone, on which account it is sometimes styled the lake limpat; the tentacula are short, and the foot oval.

Q. Are they of large size?

A. They are very small. One of the British species is found on stones in brooks, and the other on plants in ponds and ditches.

SUB-ORDER II.—GASTEROPODA BRANCHIFERA.

Q. Are there many of these?

A. A great number, and they vary so much that they admit of sub-divisions into six sections, which are named from the form and arrangement of the gills.

Q. Which are the names of the sections?

A. They are these:—

1. *Nudibranchia*,
2. *Cyclobranchia*,
3. *Tectibranchia*,
4. *Cerviabranchia*,
5. *Pectinibranchia*, and
6. *Scutibranchia*.

SECTION I.—NUDIBRANCHIA.

Q. What are the characters of that section?

A. As the name imports, the gills are naked, and consist of filaments arising from the cloak and sides of the back. They have neither shield nor shell; they have tentacula on the head, and each is both male and female. They are inhabitants of the sea.

Q. What is the first genus?

A. *Doris*, which has two superior tentacula; there are many species, of which not a few are found in the British seas. Some of them are three inches in length. The cloak is covered with papillæ, which are probably organs of touch, as the animals can extend and withdraw them at pleasure.

Q. What is the second genus?

A. *Polycera*, which has a number of small tentacula at the mouth, and jaws adapted for cutting.

Q. What is the third genus?

A. *Triton*, they have the gills disposed on each side of the cloak. The tongue and jaws are adapted for mastication.

Q. Are there many species?

A. A very considerable number, and not a few of them are natives of the British seas.

Q. What is the fourth genus?

A. *Tergipcs*, in which a row of gills on each side answer also as suckers, and enable the animal to crawl on its back.

Q. What is the fourth?

A. *Thethys*, which has an oval body, and a large winged expansion over the mouth that serves as a fin, and probably also, by agitating the water, assists it in finding its food.

Q. What is the fifth?

A. *Scyllea*, which has two tentacula, horny jaws, and extended membranes on the back, that bear the gills. It is chiefly found in the warm seas.

Q. Which is the sixth genus?

A. *Glaucus*, which has horizontal expansions, with fringed margins on the sides.

SECTION II.—CYCLOBRANCHIA.

Q. What is the general character of that?

A. The gills are distributed marginally between the foot and the cloak, sometimes entirely round, and sometimes with interruptions before and behind.

Q. What is the first genus?

A. *Phyllida*, with an oval body, the gills like horns, the mouth without teeth, and the existence of eyes is doubtful. They inhabit the warm seas.

Q. Which is the second?

A. *Diphyllida*, with the cloak pointed behind?

Q. What is the third?

A. *Patella* (the limpat) which differs from all the others in having a strong conical shell. It adheres firmly to the rocks, and is esculent.

Q. Which is the fourth?

A. *Chiton*, which has shelly plates on the back, implanted in the cloak, and no tentacula.

SECTION III.—TECTIBRANCHIA.

Q. What is their distinguishing character?

A. They have the gills under the cloak, as in last section, but they are confined to a portion of each side. They all inhabit the sea.

Q. Which is the first order?

A. *Pleurobranchus*, in which the cloak and foot invest the body, and the middle of the former has a sub-spiral shell.

Q. What is the second?

A. *Aphysia*, some of the species of which are six inches long, and give out a purple fluid when caught. Various superstitions used to be connected with it, but of course they were all without foundation.

Q. What are its characters?

A. Of an oval shape, with the cloak narrower than the body; a horny plate on the cloak, horny jaws, tantacula, and eyes.

Q. What is its common name?

A. The "sea-hare," and the vulgar belief, which is absurd, is, that the touch of it causes baldness.

Q. Which is the third genus?

A. *Dolabella*, like the last, but having a shelly plate.

Q. The fourth?

A. *Natarchus*, without a plate.

Q. Which is the fifth genus?

A. *Bulla*, in which the animals have no tentacula, and the animal is furnished with a shell, and membranous appendage to the head.

Q. Which is the sixth genus?

A. *Doridum*, which has no shell or dorsal plate.

SECTION IV.—CERVICIBRANCHIA.

Q. Which is the general character of these?

A. The gills are in the form of a plume or feather, and placed on the neck, and the animals have a spiral shell and operculum. There are two species, natives of Britain.

SECTION V.—PECTINIBRANCHIA.

Q. What is their general character?

A. The gills are contained in a sac, and the individual portions are arranged in rows, something resembling the teeth of a comb, from which circumstance the name of the section is derived.

Q. Are they numerous?

A. Very much so. The section includes nearly the whole of the univalve shelled mollusca that inhabit the sea, as well as some that do not.

Q. Which are some of their general characters, besides those of the gills?

A. The foot is, in many of the species, fortified with a moveable horny operculum; the front part of the cloak forms a thick arch, all the body behind which is constantly contained in, and protected by the shell; the head is between the foot and this arch, upon a short neck; there are two tentacula, with the eyes at their base, and the mouth is in the form of a proboscis.

Q. Is the history of those animals perfect?

A. Very much the reverse; there are numbers of them of which only the dead shells are known; and thus the knowledge that we have, and it is far from accurate or complete, is chiefly that of the shells.

Q. And is the knowledge of the shells not an index to that of the animals?

A. Unfortunately not; among the species with which we are best acquainted, we find shells that are very much alike, inhabited by animals of very different structures and habits; and animals very similar in those respects, not only inhabiting different shells, but one inhabiting a shell, and the other not.

Q. Are not the pectinibranchia divided into genera, then?

A. They are; but those genera are too often mere classifications of shells, not distinctions of kindred animals; and, besides, they are too numerous for a mere outline.

Q. How, then, may they be more simply divided?

A. Into tribes and families.

Q. How many tribes are there?

A. Three.

TRIBE I.—APERTURE OF THE SHELL ENTIRE.

Q. Is that form of shell connected with any character of the inhabitant?

A. Yes it is. Animals that have the mouth of the shell entire, must in so far leave the shell before they can breathe.

Q. What kind of shells have these?

A. They have spiral shells; and they have the cloak entire.

Q. How many families are in this tribe?

A. There are three families, which may be called *turbo*, *trochus*, and *conchylum* and *nerita*, though the first and second of them are the names of genera.

Q. What are the leading characters of the first family?

A. The mouth of the shell is nearly round, and it is uniformly furnished with an operculum, attached to the foot.

Q. Where do they inhabit?

A. They are all inhabitants of the sea, except one genus *(palmida)*.

Q. What is the most familiar type of the family?

A. The common periwinkle, or shore periwinkle *(turbo littoreus)*.

Q. What are the characters of the *trochus* family?

A. The spires of the shell are flattened, resembling a wheel (hence the name *trochus*); the aperture of the shell approaches to four cornered; they all have an operculum, and they inhabit the sea.

Q. What are the characters of the *conchylium* family?

A. They have the mouth crescent-shaped; some have an operculum, and others none; one has a spongy body instead, by means of which it rises or sinks in the water, and it has the power of ejecting a purple fluid.

Q. What are the characters of the nerita?

A. The pillar lip is nearly straight, and the mouth, in consequence, nearly semicircular, and closed by an operculum. Some of them inhabit the sea, and others fresh waters.

TRIBE II.—MOUTH OF THE SHELL WITH A CANAL OR CHANNEL.

Q. How is the channeled (canaliculated) mouth of the shell connected with the habits of the animal?

A. It contains a tube or pipe, connected with the lungs, through which the animal can breathe.

Q. Are there many distinct families in this tribe?

A. A great many; and the shells are very varied in form.

Q. Which is the first family?

A. The *Conus* of Linnæus, in which the shell is convulated with a short spire, and the operculum too small for closing the mouth of the shell, may be taken as the type.

Q. Are the species numerous?

A. There are about two hundred of them, all inhabitants of the warmer latitudes.

Q. What is the second family?

A. *Cypria* (the cowry), of which there is at least one small British species. The cloak can be reflected back over the shell, and there is no operculum. While the animal is growing the shell is cast repeatedly.

Q. What is the third family?

A. *Ovula*, from the oval form of the shell. Nothing is known of the animal. The *valva patula*, a rare British species, is *supposed* to belong to this family.

Q. What is the fourth family?

A. *Voluta*, in which the spire is almost concealed, and the mouth, the whole length of the shell, may be considered as the type. That family has no operculum (?).

Q. What is the fifth family?

A. *Buccinum*. These have spiral shells, and the animals have a retractile proboscis, with which some of them perforate the shells of mussels and other bivalves, and eat the inhabitants.

Q. What is the sixth family?

A. *Murex*, in which the animal bears a considerable resemblance to the last; but the shell is more elongated.

Q. What is the seventh family?

A. *Strombus*, in which the shell is turreted, and the aperture expands with age.

TRIBE III.—SHELL DISH-SHAPED.

Q. Are there many British species of that tribe?

A. There are two British species, *sigaretus haliotoidea*, and *tentaculatus* They are found in deep water, but are not common.

Q. What are the sizes of the *pectinibranchia*?

A. The *murex brandaris*, *pupura lapillus*, *scalaria clathrus*, and *planorbis corneus*, afforded the purple dye of the ancients; the *periwinkle*, and *nerita littorus*, are used for food; and many of the species are used by the fishermen, as baits.

SECTION VI.—SCUTIBRANCHIA.

Q. What is the meaning of that term?

A. That the gills are defended by a shield—generally of shell.

Q. Which is one of the most remarkable of the genera?

A. HALYATIS.

Q. What are its characters?

A. The foot is large, and of an oval shape; and there are simple or branched filaments round the body. The shell occupies the back with the spiral part behind; there is a row of holes on the left side of the shell, through which the filaments pass; and the shell often has a most beautiful play of prismatic colours.

Q. What are the characters of the other genera?

A. They generally have flat conical shells on the back, some of them perforated at the apex, and others not; but the nature and habits of the animals are not very well understood.

ORDER IV.—CONCHIFERA.

Q. Were the animals of that order ever called by any other name?

A. From the fact of their having no heads, they were once called *Acephala;* but the name was not very well applied.

Q. What animals does it include?

A. Nearly all the bivalves, or those in which the shell consists of two bases or valves that open and shut.

Q. How is the hinge by which the shells open and shut constructed?

A. The parts of the shells are adapted to move on each other. At the back, or outside, there is an elastic ligament, or tye, which is in a state of tension, or stretched, when the shells are shut; and in the inside there are muscles which are inserted in the shells, and serve to pull them together.

Q. And how do the valves open?

A. The animal relaxes the muscles, and the tendon contracts and pulls the fore parts of the shells asunder.

Q. Then the muscles and the ligament are on opposite sides of that part of the valves which is the axis or centre of motion?

A. They are, and they act like two forces opposed to each other, on the opposite ends of a lever.

Q. Are the actions of both voluntary?

A. The action of the muscles is, but that of the tendon is not; the contraction of the muscles by which the valves are shut, is an effort on the part of the animal, but the opening is not.

Q. Is there any evidence of design in that arrangement?

A. There is. The natural state of the animal—that in which it feeds and breathes—is while the shell is open; that is to it a state of rest or ease, and it is called to make an exertion only when it is necessary to close the shells for the securing of food, or against an enemy.

Q. Have the animals of that order any covering beside the valves?

A. They all have a cloak; sometimes open along the front, and sometimes only with openings through which it can feed and breathe.

Q. In those that have the cloak open along the front, does it open and shut?

A. It does, at the same time with the valves and in a similar manner.

Q. What is the form of the gills in this order?

A. They are in the form of leaves, situated two and two, on each side of the body of the animal within the cloak; and in those in which the cloak is open all along the front, the water has at all times free access to the gills.

Q. Have they the power of locomotion?

A. Some of them have to a small extent, and others are fastened to the same spot during the whole period of their lives.

Q. What are their means of locomotion?

A. In some it is effected, by suddenly opening and shutting the valves; in others there is a foot, and some throw out a *byssus* of threads.

Q. Do they all live in the water?

A. They do; but some bury themselves in the sand or mud, and others perforate holes, even in rocks, and make them their habitations.

Q. Is it not said that they have a particular corrosive liquor, with which they soften the rocks?

A. That has been said, but there is no truth in it, for any liquor that would dissolve rocks would dissolve their own shells. Many animals have fluids by means of which they can glue or cement substances together, but there is probably none which possess a dissolving liquor, other than the fluids by the help of which it digests its food.

Q. How then do those animals contrive to perforate hard substances?

A. By a rotatory motion of the valves of the shell.

Q. Is that habit so constant among those that have it as to be a generic character?

A. No, the same genus is often found inhabiting perforations made by itself, and the crannies among the roots of sea-weed.

Q. Have the conchiferæ organs of sense?

A. Their nervous system is very simple, much more so than that of many of the other mollusca; and the only senses which they possess are feeling, and, probably, taste, and there is no tongue or any organ for the latter.

Q. What are their organs of feeling?

A. They are tentacula at the mouth, and tentacula or fringes on the margin of the cloak.

Q. How are they produced?

A. They are of only one sex, and produced from eggs which are hatched inwardly in the gills.

Q. Are they noted for any peculiar production?

A. Yes, for the production of pearl, which, so far as is known, is not produced by any animals except the conchiferæ.

Q. Then have they all pearl shells?

A. They have, but they are different in colour and lustre; only some of them produce pearls, and then only, as is supposed, when they are in a state of disease.

Q. How are the pearls formed?

A. The particular mode of their formation is not very well known; but some form the pearl in the coats of the cloak, and some adhering to the inside of the shell.

Q. Are they widely distributed?

A. They are, but those that produce the finest pearls are confined to the warm seas.

Q. What genera furnish pearls?

A. Two species of *Avicula*, and one of *Unio*, they are indiscriminately called *pearl oysters*, and *pearl mussels*.

Q. And are they not oysters or mussels?

A. No, those that most nearly resemble the oyster, have a muscle more for shutting the valves; and those that more nearly resemble the mussel, have the cloak closed in front while the mussel lays it open.

Q. Are they all inhabitants of the sea?

A. They are not. The *unio*, vulgarly called the horse mussel, is found in most of the mountain rivers of Britain.

Q. Does that yield the most valuable pearls?

A. No, they have neither the colour nor the lustre of those found in the sea.

Q. In what sea are pearls found most abundantly?

A. Probably in the shallow strait which separates the island of Ceylon from the mainland of India.

Q. What species is found there?

A. *Avicula Margaretifera.*

Q. In shallow water?

A. No: at a considerable depth, and the fishers dive for them.

Q. Are they found also in the American seas?

A. They are; and the largest pearl ever found came from the bay of Panama in 1579.

Q. What was the size of it?

A. About as large as a pigeon's egg.

Q. Are there no other species that produce pearls?

A. Perhaps they may be sometimes produced by all the conchifera, and are met with in the common oyster and the *pinna*.

Q. Is the *pinna* remarkable for anything else?

A. Yes, for the number, length, and fineness of the threads which it spins, which threads are, on some parts of the shore of the Mediterranean, spun like silk.

Q. Is there are any other use of the conchiferæ?

A. Some of them are collected for food in great numbers, and they have a finer flavour, and are supposed to be more wholesome than any other of the mollusca.

Q. What is the classification of the order?

A. They are usually arranged into five sections; but the characters of some of these, and the manner of all, are very imperfectly known.

SECTION I.

Q. What are the characters of the first section?

A. The cloak is open, without the water comes freely to the gills and the mouth; the foot is often wanting, or while it does exist, it is not well adapted for locomotion.

Q. What then is the use of it?

A. Chiefly in spinning or fastening the byssus, by which the animal retains its place, but the mode in which that is done, and the structure of the spinning apparatus are not known.

Q. Is there any subdivision of the section, other than that of genera?

A. The arrangements are not very satisfactory, but two tribes are reckoned.

Tribe 1.

Q. What are the characters of that tribe?

A. There is but one muscle for shutting the shells the valves are unequal; and the powers of moving are always very limited, and sometimes do not exist.

Q. Which are some of the genera?

A. The oyster (*Ostrea*), and the scallop (*Pecten*), are among the best known.

Q. Are not the animals of this tribe necessarily exposed to many casualties?

A. Of course they are, as they are not capable of getting out of harm's way; and hence there are more extinct species of them found in the rocks than there are of any other.

Tribe 2.

Q. What are the characters of the second tribe?

A. They have two muscles for closing the shells; and the greater number of them spin a byssus; some too have the means of crawling by the aid of a foot. But their history is obscure, and very absurd stories are written respecting some of them.

Q. Which are the most remarkable genera?

A. The *avicula* (pearl oyster) of the tropical seas, and the *pinna*.

SECTION II.

Q. What are the characters of that section?

A. The cloak, open before and behind, and closed a little way at the middle; two muscles for closing the shells, and the shells equal. The common mussel may be taken as the type.

Q. What animals are included in this section?

A. The whole of those genera that are usually called *mussels*, whether they be inhabitants of the sea, or of fresh water.

Q. What are their means of rest and motion?

A. Most of them spin a byssus, and all of them have a foot. They, as well as many of the other tribes of the conchiferæ, are gregarious, or live in large beds.

Q. Do the mussels inhabit as deep water as the oysters?

A. They do not. The sea mussels are found most abundantly on banks where the water is shallow; oysters have always to be dredged from a considerable depth.

Q. And the fresh water mussel (*unio*), which furnishes the pearls?

A. It is generally found in the bottom of muddy pools, where the water is not very deep. It stands with the hinge end in the mud, and the shells open.

Q. How is it caught?

A. One has nothing to do but insert the end of a stick between the shells; the animal grasps the stick by closing them, and may be lifted out.

Q. Is it esculent?

A. No. It is unpleasant in scent, and understood to be unwholesome.

SECTION III.?

A. It is rather confined and obscure. The cloak has three openings, there is only one muscle to the shells, and the animals spin a byssus.

SECTION IV.

Q. What are the characters of these?

A. They have, like the former, three openings in the cloak; but they have two muscles for working the shells. The chama (the largest of the shelled mollusca), the cockle, and many others, belong to that section.

Q. What are the characters of

SECTION V.?

A. The cloak is closed in front, and though the shells are different, the animals are very much alike.

Q. Have they any peculiar character?

A. They are fond of concealment. The *teredo* bores into wood, the *plolas* into stone, and others, such as the *solen*, or razor-fish, bury themselves in the sand.

Q. Are any of them eaten?

A. The razor-fish, and some of the gapers (*mya*).

ORDER V.—TUNICATA.

Q. What is the general character of that order?

A. They are without heads; and as their name imports, they are without shells.

Q. What are their other characters?

A. One division of them remains fixed to other bodies, and the other moves freely in the water. They are all inhabitants of the sea.

Q. Are there any natural divisions of this order?

A. There are two; *tethides* and *thallides*, the former the most numerous.

1.—*Tethides.*

Q. What is their distinguishing character?

A. The outer and inner tunics, or coats, do not adhere to each other, except at the openings.

Q. Is that sub-order still divided?

A. Yes; there are two principal divisions; those that attach themselves to other substances, and those that move freely, and the former admit of more minute divisions.

Q. To what substances do they adhere?

A. To rocks, to sea-plants, to shells, some of them on peduncles, or stalks, and others not.

Q. Are they abundant?

A. They are found in all seas; all of them are of a gelatinous nature, and some are used as food. Some of them are not easily distinguished from the radiata.

Q. What seas do they inhabit?

A. They are found in all seas, and one, *synoicum turgens*, is found in the Polar sea.

2.—*Thallides.*

Q. What are the characters of these ?

A. The character which distinguishes them from the former, is the adhesion of the two tunics for their whole extent.

Q. What seas do they inhabit ?

A. Chiefly the warmer seas, in which they are pretty numerous.

ORDER VI.—BRACHIOPODA.

Q. What are their characters ?

A. They are without heads; the cloak is divided into two parts, and they are protected by bivalve shells. They can roll their arms up in a spiral form.

Q. Which are some of the genera ?

A. *Lingula, terebratula* and *criopus* ; but their habits and history are not very well known.

Q. Of what does *lingula* consist ?

A. Of a cartilaginous stalk or peduncle, which has one end fastened to other bodies, and the other end carrying the body of the animal with two valves of shells.

Q. Are there many species ?

A. There is only one species, *lingula unguis.*

Q. What is the character of *terebratula* ?

A. The muscular peduncle passes through a hole in the larger valve of the shell. They are chiefly found in a fossil state.

Q. What are the characters of *criopus* ?

A. One of the valves is a membrane and not a shell, and the other resembles in form the shell of a limpat.

Q. How does it fasten itself?

A. The membranous nature of the shell adheres to stones, so that the animal has been mistaken for a species of limpet.

THE END.

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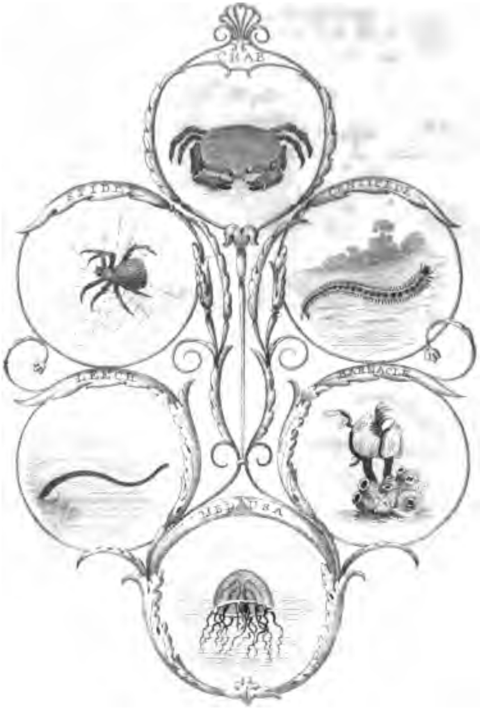
HENRY BAYLIS, JOHNSON'S-COURT, FLEET-STREET.


CRAB
SPIDER
CENTIPEDE
LEECH
BARNACLE
MEDUSA

PINNOCK'S

CATECHISM

OF

ZOOLOGY.

PART VII.

CRUSTACEA. &c.

LONDON.
PRINTED FOR WHITTAKER, TREACHER, & Cº
AVE MARIA LANE
183.

CATECHISM OF ZOOLOGY.

PART VII.

CRUSTACEA, ARACHNIDES, MYRIAPODA, VERMES, CIRRHIPEDES, AND RADIATA.

NOTE.

In order that the Catechisms of Zoological subjects might contain at least an approximation to a general view of animated nature, this one has been formed to embrace some of the minor departments. Any one of these would have required more space than can, in this little work, be devoted to the whole; but the greatest care has been taken to select those points which are the most general, and at the same time the most interesting. Those who are acquainted with the subject, do not need to be told, that it is one, in the forming of an epitome of which there are great and almost insurmountable difficulties.

PART I.—CRUSTACEA.

Q. What is meant by *Crustacea?*

A. Crustacea, or crustaceous animals, are those that have their bodies covered with a hard envelope, *(crustus)* which forms the proper covering or integument of the body, and from which they cannot detach themselves, in whole or in part, as the testaceous *mollusca*, or shelled worms, can do from their shells.

Q. Does it differ from the horny covering of insects?

A. It does. Crusts generally contain salts of lime, both the carbonate and the phosphate, and thus they partake a little of the nature both of shell and of bone; but as they contain much more of the carbonate than of the phosphate, they resemble shell more than they resemble bone.

Q. Is that in accordance with the other characters of the animals?

A. Yes, the crustacea in their general character and economy, resemble the shelled mollusca more than they do the animals that have hard bones.

Q. Is there any other peculiarity in the composition of crusts?

A. Yes. In the animal matter by which the salts of lime are cemented together, they appear to differ from bone, and shell, and horn, and to resemble the shells of eggs more than any other hard substances.

Q. In what does the difference consist?

A. The animal cement of bone, shell, and horn, is understood to be gelatine, while that of crusts is albumen.

Q. What difference does that produce?

A. Crusts boil hard from the coagulation of the albumen, and thus they become brittle rather than flexible.

Q. Is there any further peculiarity in the crustacea?

A. They differ from insects and the shelled mollusca, in having internal bones in the members of some of the species.

Q. Are those internal bones hard?

A. No, they are cartilaginous, as may be seen in the central bones of the different joints or segments of a crab's claw.

Q. What are the animals that are, properly speaking, crustaceous?

A. Those which are familiarly known by the names of crabs, lobsters, shrimps, and prawns.

Q. Are not these fishes?

A. They are popularly called shell-fish, and the ancients considered them as a sub-class of fishes, intermediate between the fishes properly so called, and the shelled mollusca.

Q. And are they not fishes?

A. Certainly not, they have nothing in common with fishes except breathing by gills, and that alone no more makes an aquatic animal a fish, than breathing by lungs makes a land animal a bird. Gills are the apparatus for breathing in the water, just as lungs are for breathing in the air, and thus, though each of them points out the element in which the animal lives, neither of them determines the class to which it belongs.

Q. Have they not been classed with insects?

A. They were so classed by Linnæus; but the classification is at variance with anatomy and physiology, and even with external appearance. In some feparticulars they agree with insects, but they differ from them in many more.

Q. In what do they agree?

A. Almost the only points of agreement are, having the muscles partly inserted, (the true insects have them wholly,) in the crust, and in having jointed legs and antennæ, and the muscles of each joint contained in the joint itself.

Q. In what do they differ from insects?

A. They breathe by gills; they have generally four antennæ or horns, while the insects have only two; they have often six *mandibules* or jaws, while insects have no *mandibules* properly so called.

Q. Are there any further differences?

A. Yes, there are, which render the crustacea a more perfect class of animals, so to speak, than the insects.

Q. What are these?

A. The crustacea have a heart, the insects have not: they have a more regular and complete nervous system; they undergo no transformations—the young differing from the old only in size; and they produce young more than once, whereas the true insects die whenever they have once deposited their eggs, or otherwise produced *one* brood.

Q. Do not the crustacea cast their crusts annually, which is a sort of metamorphosis?

A. The vulgar opinion is, that they do cast them every year, and while the animal is young this may be true, but that it is not the case at more advanced ages, is proved by the fact that substances have been formed upon the crusts of crabs and lobsters, which must have taken two or three years to grow, and which yet must have grown upon the crusts.

Q. What are the internal or anatomical characters of the crustacea?

A. They have the blood white and cold; a single heart; no vertebral bones; the spinal cord with many ganglia or knots; they breathe by gills, and they have muscles for moving the feet.

Q. What are the external characters?

A. They have naked jointed feet formed either for swimming or for running, the covering varies with the species, from a membranous to a very hard crust. It is in the form of a shield, and sometimes bivalve; and the gills are always under the crust.

CLASSIFICATION.

Q. How are the crustacea divided?

A. Their classification is not entirely settled, but the common division is into *entomostraca* and *malacostraca*.

ENTOMOSTRACA.

Q. What are the characters of these?

A. They vary very much in the species, but the following are some of them: they have the feet fringed, or with leaf-like processes; covering leathery; sometimes a shield, sometimes bivalve; the eyes generally fixed, but sometimes on foot-stalks or pedicles.

Q. What is the number of eyes?

A. Generally two; but they are sometimes so united as to appear as only one.

Q. What is the character of the mouth?

A. The mouth is sometimes furnished with jaws, and sometimes with a proboscis; the mandibles are without palpi, and generally obscure; there are four maxillæ with double palpi.

Q. What are some of their other characters?

A. They have generally two feet formed for swimming, and the tails are furnished with bristles or plates, or sometimes with a sword-shaped process.

Q. Are there many of them?

A. There are at least twelve known genera, and there may be very many more.

Q. Are they classed into families?

A. They are, into six families.

Q. Which is the first?

A. *Xiphosura*, so called from having the tail lengthened, three sided, and horny, something in the shape of a sword.

Q. Are there many genera of that family?

A. There are only two; the one luminous, and not very well known, the other a very singular animal.

Q. What is it?

A. The "king crab," *limulus polyphemus*, an inhabitant of the Indian seas, where it attains the length of four feet, or more. The shell is in two divisions, with a keel on the back; the eyes very small and placed far back on the sides; there are two legs, all with a fixed thumb and moveable finger; spines on the upper keel of the shell, and that of the tail notched.

Q. Are there any more species?

A. There are, all inhabitants of the Indian seas, and chiefly differing in being without spines on the shell, and divided claws on the fore-feet.

Q. Which is the second family?

A. *Pneumonura* (fringe-tailed). They are all small; some of them inhabit fresh water, some salt, and they are generally parasitical on fish. Mouth formed for sucking.

Q. Which is the third?

A. *Phyllapoda* (leafy-foot). Very small; lives in rivulets and ditches.

Q. What are the characters of the rest of the division?

A. With the exception of the *limuli*, they are all very minute, some have two eyes, some only one; the greater part are parasitical, and fasten themselves to other animals by the claws of the first pair of legs. Sharks, cod, and other pelagic fishes, are often very much infested by them, and when they fasten in numbers upon the gills, the fish feels very uneasy. One of those animals, known to the fisherman by the name of the sea-louse, or salmon-louse, is supposed to assist in driving the salmon out of the deep water into the rivers; but the story may be a fable.

MALACOSTRACA.

Q. Are these more numerous than the former?

A. They are, and they are also larger, not so apt to be confounded with the larvæ of aquatic insects, and therefore they are a little better understood, though their history is far from perfect.

Q. What are the divisions of them?

A. One general and very obvious division is in those that have the eyes upon footstalks, and those that have not. The former are the more numerous and important, and they admit of a further subdivision from the tails.

Q. What are these?

A. Those that have the tail short and simple, and those which have it with appendages, and longer than the body.

Q. Which are some of the families?

A. The first are *Cancerides*, or crabs, properly so called. They have the shell in general without spines, ten feet, and the front pair formed into pincers.

Q. Is there any thing peculiar about the feet of those animals?

A. They have the power of reproducing them when broken off, and some, when caught by a leg, give themselves a violent jirk, shake off the leg, and escape.

Q. Which are some of the useful ones?

A. Of the genus *podopthalamus*, or those that have the eyes upon footstalks is so long, that they appear like horns, *Mænas* is a species very much eaten by the poorer people.

Q. What are its habits?

A. It is found on most rocky shores, under sea-sand and stones; it is green, mottled with black, has only one tooth on the hands and a spine on the wrist.

Q. Is there not a very beautiful species of that genus?

A. Yes. *Puber*, which has the shell covered with [illegible], the claws beautifully mottled with blue and black, and the eyes striped with scarlet and blue; its swimming feet are very broad.

Q. Is it found in the British seas?

A. Yes, on the rocky shores, on the south-west of England.

Q. Is there any other beautiful one of the genus?

A. Yes. *Marmoreus*, the marbled crab, which is found in the same places as the other, and is beautifully mottled red and white.

Q. Any other worthy of notice?

A. Yes. *Depurator*, which the sailors call the flying crab, and suppose that it destroys oysters, by putting its flat foot into the shell when opened; but neither that nor the flying is true.

Q. Which is the most valuable genus?

A. *Cancer*, of which *cancer pagurus*, the common crab, is the most valuable species.

Q. What are some of the characters?

A. The shell is narrow behind; the hands are very large, and longer in the male than in the female; there are nine folds or plaits on each margin of the shell; and the tips of the hands are black.

Q. When is it in season?

A. Twice in the year, from Christmas to Easter, and in harvest.

Q. What are its habits?

A. It is exceedingly voracious, and feeds on all manner of garbage, and probably on star-fish, and other radiata. In the summer months it frequents the rocky shores, where the water is of considerable depth; but in winter it is not so frequently to be met with.

Q. What becomes of it then?

A. It is understood to bury itself in the sand; ar many are dug up on sandy shores adjoining rocky ones; but whether they all bury themselves in that manner is not known.

Q. What is the means of catching them?

A. There are various ways. In the regular fishery, wicker baskets are used, constructed like a large mouse-trap, and baited with the refuse of fish or any other garbage; and sometimes strong nets baited in the same manner. They are also taken with a hook at the end of a pole, and sometimes with the hand, but in the latter case the large claws or hands must be avoided, as these pinch very severely.

Q. What are the places where crabs are chiefly found?

A. They are largest and best in the north sea, on the shores of Norway; the Orkney and Shetland isles, and the rocky parts of the east coast of Britain, as far south as the entrance of the Humber.

Q. Is there any part of their habits that renders them more easily captured?

A. The male and female remain in the same hole at low water; and if the males be all taken out at one tide, others are certain to be found at the next, so that two a day may be had from a hole of this kind for some weeks.

Q. Is there not a genus remarkable for the rapidity of its motions?

A. Yes, the genus *Ocypode* (nimble foot). They are chiefly found in warm latitudes where they swarm in muddy places. Their hands and feet are horny, they burrow in the mud, and run with so much velocity that there is no catching them, unless their holes are previously stopped.

Q. Is there not a species that lives on land?

A. There are several species in the West India islands that make annual journeys from the mountains to the sea and back again, keeping some sort of order in their march, moving during the night, and hiding themselves during the day; but their characters and habits want examination.

Q. For what purpose do they visit the sea?

A. To deposit their eggs or spawn, it is supposed.

Q. And for what purpose do they visit the land?

A. That has not been ascertained.

Q. To what size do they grow?

A. The largest about six inches long in its shell.

Q. Are they eatable?

A. The light coloured ones are eaten; but the black are said to be poisonous.

Q. Are not there some crabs that inhabit the shells of other animals?

A. Yes, the genus *pinnatheres*, and especially the genus *pagurus* (not *cancer pagurus*), the members of which are called soldier crabs, or hermit crabs, take possession of the empty shells of mollusca, and shift from shell to shell as they increase in size, and their old dwelling gets too small for them. Humorous stories are told about their running along on a beach where there were empty shells till they found one that fitted.

Q. Are not there some crabs that are remarkable for their uncouth appearance?

A. Yes, some species of the genus *maia* are remarkable for their spiny shells, and hence have got the specific name of *horrida*. Another species of the same genus is, from its form, called the spider crab, oharpy crab. The oyster dredgers dislike it very much, and *suppose* that it is destructive of the oyster beds.

Q. Which are the most remarkable animals of this class with the tails longer than the bodies?

A. Those which are of most value as food, are the different sorts of lobsters, cray-fish, prawns, and shrimps.

Q. What are the lobsters?

A. There are several species that get the name of lobsters, but those best known are the common lobster, or sea lobster, *astacus gammarus*, and the river lobster, or common cray-fish, *astacus fluviatilis*.

Q. Where does the sea lobster inhabit?

A. It is found on the rocky shores of the east and north of Britain, but is much more abundant on those of Norway, from whence the London market is chiefly supplied. Its favourite haunts is in clear deep water, where the rocks overhang.

Q. Is it a prolific animal?

A. Remarkably so; more than twelve thousand eggs have been found under the abdomen of one female.

Q. Are they active?

A. Very much so in the warm weather, and when alarmed they start backwards a great way to their holes.

Q. What is their food?

A. They are very voracious, and eat all sort of dead bodies, garbage, and probably sea weed.

Q. Where does the cray-fish inhabit?

A. European rivers, especially such as have a clayey bottom It makes holes in the banks for its retreat, in which it continues for the most part during the day, and comes abroad in the night to feed, which it does both upon animal and vegetable matter. There is a Norwegian species found in the sea, of which, when alive, the flesh is red.

Cray-fish boil red as well as lobsters, but as their natural colour is paler so is their colour after they are boiled.

Q. What is the prawn?

A. *Palæmon squilla*, of which there are several varieties, the largest about five inches in length.

Q. Where are they found?

A. On the shallow shores of the ocean, or in pools left by the tide. They are most abundant in the latter, and are easily caught by a small hoop-net.

Q. What colour are they when alive?

A. Ash colour, beautifully banded with brown, but they boil to a fine red.

Q. How do prawns differ from shrimps?

A. In general they are larger, and they have both a finger and thumb to the hands, while the shrimp has only a moveable thumb.

Q. What is the name of the shrimp?

A. *Crangon vulgaris*. It is found in the shallow water on most sea-coasts in Europe.

Q. What is its colour when alive?

A. Ash colour nearly transparent, finely mottled with brown. It boils to a sort of salmon colour.

Q. Is not there an animal resembling a shrimp in which the female has a sort of pouch for carrying her young?

A. Yes, the genus *processa*, which is found nearly in the same places, and has much the same appearance as the shrimp, only it wants the moveable thumb on the hands.

Q. Is not there a race of crustacea called sand-hoppers, that are very numerous on the sea beeches?

A. Yes, the family of *gammarini*, which are exceedingly numerous, so that when one walks along the sand just about the line of high-water-mark when the tide has retreated a little, the whole place seems alive with them.

Q. What appears to be their use in the economy of nature?

A. They consume almost instantly those putrid substances which the sea leaves behind at every tide, and which are without the reach of the other crustacea.

Q. Are there several genera of them?

A. Yes; the genus *talitrus* includes the sand-hoppers properly so called, and gammus, the rather smaller animal, some species of which are found only in fresh water and some only in salt. They are vulgarly called sea fleas and sea locusts.

The *shrimps* that make their appearance in impure water, when not the larvæ of insects, usually belong to this family, and resort there to perform that scavenger's duty which man has neglected.

Q. Have the gammarini the eyes on peduncles like the crabs and lobsters?

A. No, they have them close to the head.

Q. Are any of these small crustacea destructive?

A. Yes, *limnoria terebrans*, a small species that inhabits the British ocean is very destructive to timber, and the millipede, or carpenter, which is very common in rotten wood and old walls, helps the destruction of both.

Q Has not the last been celebrated in medicine?

A. Yes it has, without deserving it.

PART II.—ARACHNIDES.

Q. What is the meaning of Arachnides?[*]

A. Animals which resemble spiders, including in the class the spiders themselves.

Q. What are the internal or anatomical characters of those animals?

A. They have no vertebræ, have the heart single, breathe by lungs or air-pipes, and have muscles for moving the feet.

Q. What are the external characters?

A. The feet are jointed, generally eight, but sometimes six; the external openings of the trachea or wind-pipe visible; no wings, and rarely any other change than that of casting the skin.

Q What is the arrangement of this class of animals?

A. They may be divided into two sub-classes—those that have the mouth in front of the head, and those that have it on the back.

Q Are there any of them that have the mouth in the back?

A. There are; they are very minute and singularly formed animals. *Pythridium Hermanni* is a specimen. It has six legs, with two strong claws to each, acting against a spoon-shaped process. It is found on the bodies of the horse-shoe bats.

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[*] Arachnides, from the Greek Αραχνη, a spider, and ειδος, resemblance, resembling spiders.

Q. What are the divisions of those that have the mouth in front of the head?

A. They are divided into four orders:

1. *Podosomata*, the body apparently formed of the thighs.
2. *Polymerosomata*, the body made up of many joints.
3. *Duomerosomata*, the body made up of two joints.
4. *Monomerosomata*, the body composed of a single segment.

ORDER. I.

Q. What are the characters of the first order?

A. The body is four jointed, as if made up of the thighs of the eight legs; there are four eyes; the mouth is a sucker; and the female has apparatus for carrying her eggs.

Q. Where do they inhabit?

A. They all inhabit the sea, and are generally called sea-spiders. They have a strong claw at the end of each leg, and some of them seem almost entirely made up of legs.

Q. Which is one of the species?

A. *Nymphum gracile*, which inhabits the north sea, has forceps on its mandibles, and is supposed to perforate the shells of mussels and suck their juices.

ORDER II.

Q. What are the characters of the second order?

A. The body is composed of a number of segments: there are eight legs; the mouth is furnished with both mandibles and maxillæ, and the eyes are two, four, six or eight.

Q. Which are the most remarkable genera of this order?

A. *Scorpio* and *tarantula.*

Q. What are the characters of scorpio?

A. *Scorpio,* the scorpion, is a singularly formed animal, and in some of the warm parts of the world, rather a formidable animal.

Q. What is the form?

A. The body is cylindric, the thorax one ring, the abdomen many, and the tail long, jointed, and ending in a double scale; toothed, called the pecten, and armed with a crooked poisoned sting. There are four eyes, and eight legs, besides the front pair, which are antennæ, and much larger than the others, and armed with pincers.

Q. What is the colour?

A. Dull brown, with the tail inclining to yellow.

Q. What is the size?

A. In Europe, (and it is found only in the very warmest parts,) it seldom is more than an inch in length, exclusive of the tail, but in warm countries it is sometimes five inches.

Q. Is the sting of the scorpion painful?

A. All venomous bites and stings are painful: but that of the scorpion is not fatal to a healthy human being in any country, though in the very warm countries it is said to be capable of killing a dog.

Q. Does the scorpion use its sting as a weapon of defence?

A. It does. When an enemy appears, it bends forward the tail till the point be farther in advance than the head, and stands ready to strike with the sting.

Q. In what places do they live?

A. Under stones, and amòng rubbish; they are solitary, and seldom come abroad till the evening, when they catch insects with their pincers. They sometimes find their way into houses, and even into beds.

Q. Are there any other animals that have some resemblance to scorpions?

A. Yes. *Sico*, *Abiscum* and *Clikifer*, have pincers, and the same number of legs as the scorpion, but they are without tails or stings.

Q. Are they found in Britain?

A. They are, but they are not very common. The first is found among moss, the second under stones, and the third below the bark of trees.

Q. Is the tarantula, which belongs to this order, that of which the bite is said to be cured by music?

A. No; that tarantula is a spider. The *tarantulidæ* with many joints are all natives of warm countries, and none of them have stings or poison.

ORDER III.

Q. What are the characters of the third order?

A. The animals belonging to it have the body made up of two segments, with the abdomen attached by a slender peduncle; they have eight legs, six or eight eyes, and the mouth furnished with mandibles and maxillæ.

Q. What are the principal animals in that order?

A. The most interesting, and indeed the most curious of all the small animals, are the *araneideæ*, or spiders, properly so called.

Q. Are not they very destructive creatures?

A. They consume a vast number of insects, and their doing so is of very great advantage in the economy of nature ?

Q. Of what advantage is it?

A. The time when the spiders make their appearance in the greatest numbers, is towards the autumn, just before the flies deposit their eggs, ere they perish for the season; and were it not for the numbers that the spiders destroy before that operation is accomplished, every spring would bring a plague of flies that would be absolutely intolerable.

Q. Would the houses be filled with them?

A. In that way they would be annoying enough: but the more destructive flies, that deposit their eggs on vegetables, would be far worse, and but for the labours of the spiders there would neither be leaves nor fruit.

Q. Do not some of the insects retaliate upon the spider?

A. They do, the *sphex*[*] especially, which impales vast numbers of them as food for its young.

Q. What are the general characters of spiders?

A. The abdomen is generally large in proportion to the size of the animal, and it is united by a slender peduncle. The other part of the body is sepile. There are eight legs, generally armed with strong toothed claws, one of which acts against a thumb, and the two can be used either as a hand, or as scissors, with which to cut the threads of the web when that is necessary.

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[*] See Catechism of Entomology.

Q. How many eyes have they?

A. They have eight eyes, disposed in different ways.

Q. That must enable them to see very well?

A. Not so well, as from the number one would suppose; for the eyes are not moveable, and each of them consists only of a single lens, so that for all their eight eyes, they are rather deficient in power of vision.

Q. Then what is the sense on which they chiefly depend?

A. On the sense of touch, which is so delicate, that while a spider hangs motionless in the centre of its web, or even concealed in the nest which it sometimes constructs for itself, it can not only feel when any object touches only a thread of its web, but feel whether that object be dead or living, and whether it is to be taken as a prize, or captured as an enemy.

Q. How is that ascertained?

A. Any one that pleases to observe, may see it, and there is no spider better for the purpose, than the large and beautiful spider (*epeira diadema*) which is so common in gardens in the latter part of the season.

Q. What may be observed of that?

A. The spider generally reposes either on the middle of the web, where there is a thicker place for the purpose, and threads from all parts of the web, or it reposes on a leaf entirely out of sight.

Q. Well?

A. If a fly alights, the vibrations that it makes in its attempts to escape, soon brings the spider, and the fly is instantly shrouded in a mass of web, so that it may be eaten at leisure.

Q. If a bit of leaf is brought on the web?

A. The spider comes, and, with no little skill, detaches it, so that it may not be again entangled in pulling; and when the web is cleared, the spider takes a rest, and then returns to repair the damage.

Q. And if another spider is put on the web?

A. That is another matter, and demands some consideration. By trying the principal lines of the web with its feet, the spider soon finds out the strength of the visitant. If weaker, it hastens to make prize; and if stronger, it makes its escape, or sometimes divides one of the main-stays of the web, and drops web and enemy to the ground.

Q. What is the usual means of escape?

A. Dropping down by a thread, which is spun in the fall.

Q. What are the weapons of a spider?

A. They are a pair of claws or forceps, the last joint of each of which is moveable, hooked, and very sharp.

Q. Is not the bite of a spider venomous?

A. There does not appear to be any thing venomous about spiders. Some of their cutting claws have a groove; but it is not connected with any poison apparatus, being a mere mark in the claw. The bodies are not poisonous, for many animals eat them with great avidity; and the web is so free from being poisonous, that it has been used in medicine, and is far from the worst application to stop bleeding, and heal a wound by the first intuition.

Q. Then a spider can do no harm ?

A. No very serious harm, certainly, although its biting apparatus are admirably constructed for their size.

Q. Then what is the grand weapon of the spider ?

A. The web, unquestionably. When away from that, the spinning spider is a very helpless and timid animal.

Q. How is the web produced ?

A. From a spinner at the hinder part of the abdomen, which consists in general of fine little protuberances or nipples. The animal presses these against any substance, and draws out the thread either by receding from the place, or by its legs.

Q. Are there as many threads as nipples ?

A. There are a great many more. A round thread can be spun of various strengths, and when that is necessary, the thread can be drawn out broad like a ribbon. The first form is used in constructing the web and providing for the safety of the animal; the second [illegible]ing up the prey.

[illegible]n they do not secure their prey by biting ?

[illegible]y of them wrap it in a mass of web, more [illegible] if it be strong, as a wasp, a blue fly, or ano[illegible]er.

[illegible] complish that ?

A. They first bind it round the wings, if winged, then fasten a strong thread to it, push it clear of the web, twirl it rapidly round with two of the feet, while the other two dart the ribbon of web, first to the one end of it, and then to the other, until the diagonal layers form a complete case.

Q. And does that take a long time?

A. Not more than a minute; and the operation is as neat as that of the patent machine for winding balls of cotton. The motions of the legs that regulate the thread are so rapid, that unless carefully watched, they cannot be seen.

Q. Do not some spiders sail on their webs in the air?

A. They do; and though observers are not agreed, it is possible that they draw out the threads for that purpose in the same manner as they do those for shrouding their prey.

Q. How do they contrive to extend their lines from tree to tree?

A. It is not very easy to say. Sight cannot help them much. The best way is to examine them, which anybody may do.

Q. Could not the webs of spiders be used as silk?

A. None of the European species could be used, though some of the larger ones in the warm countries are said to afford a coarse-spun silk; but spiders could not any where be cultivated like silk-worms, as the large ones would instantly eat up the small.

Q. Are there many species of spiders?

A. There are many genera, and even a cons number of tribes, some of them with the feet adapted for leaping, and some not.

Q. Which is the largest that is known?

A. The bird-spider of South America, *mygale avicularia.*

Q. What are its dimensions?

A. The body is said to be sometimes as large as the egg of a goose.

Q. What is its appearance?

A. The body is covered with long and thick black hair, the feet are broad and heavy.

Q. What are its habits?

A They are not very accurately known; but it is said to snare birds as well as insects.

Q. Is that likely?

A. It is not at all unlikely, as some of the humming birds in the same country are small enough for being taken in a common garden spider's web.

Q. Which is *supposed* to be the most formidable of the European species?

A. *Lycosa tarentula,* which is supposed to have a stupifying bite, from the effects of which the sufferers recover when certain tunes are played.

Q. And is that not true?

A. At all events it is not very likely; and the poisoning apparatus, even in the large foreign species, have not been observed.

Q. What is the appearance of the tarentula?

A. It is a brownish grey spider, found only in the warmer parts of Europe.

Q. Which are some of those that can be most easily observed in Britain?

A. The field-spider, the house-spider, and the garden-spider.

Q. Is there only one in each of those situations?

A. There are many; but those that have got these names are the most common.

Q. Which is the field-spider?

A. *Aranea labyrinthica.* It is reddish grey on the body, with a black line on each side; the abdomen black, with oblique white lines that meet at obtuse angles in front.

Q. Where does it form its web?

A. On the ground; and it constructs a funnel-shaped cavity for itself, which often reaches below the surface.

Q. What is its prey?

A. Chiefly two-winged insects.

Q. What is the house-spider?

A. Another species of the same genus, *aranea domestica.* It is livid grey, and the male wants the black line on the thorax. The abdomen is not so black, and wants the white lines.

Q. Where does it construct its web?

A. Generally in the corners of neglected apartments. They are of a closer texture than those of the former. It makes a cell for itself, and unites that cell with the web by a bridge, which answers the double purpose of announcing that there is a fly in the web, and facilitating the progress to it.

Q. Do those spiders roll up their prey in the way that you have mentioned?

A. No; their webs, which are nearly horizontal, are not very well adapted for that purpose; so th either carry their prey to the cell, or eat it where it is caught.

Q. What is the garden-spider?

A. *Epeira diadema.* It is reddish, often of large size, and rather handsome. It is one of the most amusing of the class, and one of the most easily observed.

Q. Are there any spiders in fresh water?

A. There are. *Argyroneta aquatica* is one of them. It is plushy brown, with the abdomen black and velvety.

Q. Does it form a web under water?

A. It forms a nest, and contrives to fill it with air; so that when the sun shines on it, it is very brilliant.

Q. Where does it inhabit?

A. It is met with in slow-flowing streams on the continent; but in England it is exceedingly rare.

Q. Are there many spiders that catch their prey without webs?

A. There are several, chiefly long-legged and comparatively small-bodied ones, that run very swiftly among grass and stones.

Q. To what age do spiders live?

A. That is not exactly known.

Q. How are they produced?

A. Invariably from eggs, without any transformation; but in some of the species the female carries her eggs about with her in a bag, and fights stoutly if an attempt be made to deprive her of them.

Q. Do they begin to spin at an early stage of their 'ives?

A. Yes; when the crust in which a nest of them are hatched is broken, and they are so small as hardly to be visible to the naked eye, the little things spin threads that are absolutely invisible, and discovered only by arresting their fall.

ORDER IV.

Q. What are the characters of the fourth order?

A. The animals belonging to it have the body formed of a single piece or segment; the legs are sometimes eight, and sometimes six; and the mouth is sometimes a rostrum for sucking, and sometimes it has mandibles and maxillæ.

Q. What is the general character of the animals of this order?

A. Their characters are various; but in general they are small animals; many of them are parasitical on beetles and other insects.

Q. Which is one of the families?

A. The *acarideæ*, or mites, one of which is well known as the common mite that inhabits cheese, flour, and other substances that have been long kept. Other tribes attach themselves to the bodies of animals, and some are found in sores.

Q. Whether does the animal occasion the sore, or the sore the animal?

A. Neither of them originally produces the other. The animal cannot be produced without an egg, small though that egg be; and as it does not appear without the sore, the sore must be there to hatch it.

Q. Are there not some very beautiful animals that belong to this class?

A. Yes; one of the *hydrachnedeæ* is extremely beautiful.

Q. Where is it found?

A. In gently-flowing streams, and is by no means uncommon in some parts of Britain.

Q. What is it like?

A. Its body is globular, its mouth elongated into a conical sucker, and its legs, of which there are eight at equal distances, beautifully feathered with hairs. Its colour is black, marked with streaks and spots of a a very brilliant red, and most elegantly arrayed.

Q. Are those that have been mentioned the whole of the arachnides?

A. Not nearly. The numbers are so many, the forms and colours are often so fine, and the habits so singular, that these little creatures form one of the most interesting departments in the empire of nature.

PART III.

MYRIAPODA.

Q. From what are the *myriapoda* named?

A. As the name imports, from the great number of feet.

Q. What is their internal structure?

A. They have a nervous ganglion in each ring, or segment of the body; and these are united by a continuous bundle of nerves, which cannot, however, be considered as a spinal cord.

Q. What are their external characters?

A. They have the head distinct from the body, and furnished with two antennæ; they have simple mandibles, fitted for cutting; the segments of the body have generally either two or four legs attached to each.

Q. What is their general appearance?

A. Their bodies are in general long in proportion to their diameter; they are either cylindrical or compressed; they are remarkable for their great number of feet, and some of them terminate posteriorly in a kind of forceps. Their history is, however, a little obscure.

Q How are they divided?

A. They may be divided into two orders, each three families.

Q. What are there in the first?

A. They are—

1. *Glomerideæ*, with the eyes distinct, and the body capable of being contracted into a ball.
2. *Julideæ*, with the eyes distinct, but the body not contractible into a ball.
3. *Polydermideæ*, with the eyes obsolete.

Q. Mention a specimen of the first family.

A. *Glomeris marginata*, with the body a lengthened oval, convex above, arched below, with sixteen pairs of legs. Colour black, but the segments margined with orange.

Q. Where is it found?

A. Under stones, in France, Germany, and Britain, but its habits are little known.

Q. Mention a specimen of the second family?

A. *Julus sabulosus*, with an immense number of legs. Ash coloured and black, with two reddish lines down the back; found under stones.

Q. Mention one of the third family?

A. *Polydesmus complanatus*. Body linear, segments compressed; four legs in each; legs very many; eyes not visible; found under stones.

Q. Which are the families of the second order?

A. There are three of them—

1. *Carmatidea*, with each of the segments having four legs.
2. *Scolopendrideæ*, with each segment bearing two legs; and the last pair longer than the others.
3. *Geophilideæ*, with each segment bearing two legs; the legs very many, and the last pair not longer than the others.

Q. Are any of the first family found in Europe?

A. No. Those that are known are natives of Africa, where they are found in houses.

Q. Are any of the second family natives of Europe?

A. Two, at least; one of them in gardens in the south of England. The scolopendra, properly so called, are larger, and natives of warmer climates; but their history is very obscure.

Q Any of the third family?

A. Yes. There is a yellow and scarlet one, found in fruits in the south of England, and two others, found in the earth, and under stones. Some of the species are phosphorescent, and not only give out light, but leave trains of light behind them.

Q. Of what use are the *Myriopoda*, in the economy of nature?

A. Their habits have been so little studied, and are in themselves so obscure, that it is impossible to say. The whole class form a department yet to be studied, as neither their food, their mode of production, nor their duration is known.

Q. If their history is so obscure, may they not belong to the class of insects or to that of reptiles?

A. No, they do not undergo those transformations that are characteristic of insects, and the total absence of any thing that can be considered as a backbone, prevents them from being classed with reptiles. They have a common and very peculiar character, though that character has not been much studied.

Q. What may be the probable causes why their history has been less attended to than that of the other classes of animals?

A. One cause has no doubt been the classification of them with the wingless insects; and others are found in their retired habits?

Q. Are they a harmless race of creatures?

A. There is no reason to suppose that any of them does the smallest injury to man, or to any of his possessions.

Q. Are they of any use?

A. The uses of them are just as little known; some of them have been used in medicine; but as many substances which are not of the least benefit have been employed in that art, it is probable that they had only the merit of being harmless.

Q. Have they been used as food?

A. Not by man, but as some animals eat them, they might probably be used.

PART IV.—VERMES.

Q. What is meant by *vermes*?

A. The literal meaning of the name is worms; but as that, in the popular sense, is rather a vague term, the name is properly restricted to those annular animals that have no distinct head, no antennæ, and no legs of any description whatever.

Q. Where do they inhabit?

A. Some of them inhabit the fresh waters, others the sea; some inhabit damp places, and others live entirely under the earth. They are a singular race of animals, and their habits and classification are but little understood.

Q. What are their means, or organs of motion, seeing they have no legs?

A. Those necessarily vary a good deal with the structure of the animal. Those that live in the water make their way by swimming, which they accomplish generally by throwing their bodies into curves, not very unlike those of an eel. They can also make their way by means of suckers, either along rocks and other solid substances in the water, or along the land. Those that inhabit the land, make their way partly by a slimy fluid, by means of which they attach themselves, and partly by means of little spines with which their bodies are beset.

Q. What are the principal divisions of these ani-
's?

A. They may be divided into two orders; those in which the organs of respiration are concealed, and those in which they are external or apparent.

Q. Are there many species in each of these?

A. There are a good many, but most of them are imperfectly known, and therefore confused.

Q. What are the principal subdivisions of those that have the organs of respiration concealed, or internal?

A. They are four?

1. Those in which the body is rounded, and beset with little spines.
2. Those in which the body is rounded or flattened, and furnished with a sucker at each extremity.
3. Those in which the body is flat, naked and smooth, and without any sucker.
4. Those which have the body flattened, and with little bristles on the sides.

Q. Which is one of the first division?

A. *Lumbricus*, the common earth-worm, or dew-worm.

Q. What are its characters?

A. Its structure, internally, is very simple, consisting of a single straight canal; it breathes by the extremity, and performs its motion by the joint action of the muscles of its rings, and the little spines or bristles with which it is beset.

Q. Has it any organs of sensation?

A. It has sensation, but the organs have not been found, neither can we compare the sensation that it has with the senses of the more perfect animals. It has no eyes, and therefore we cannot attribute sight to it, as little can we find a locality for smell, yet the creature seems to have very adequate means of knowing what is going on, in so far as its own existence and comfort are concerned.

Q From what do we infer that?

A. We do not need to infer it, we see it. If it were to come abroad in the hot sun, it would be shrivelled and dried, so that it could not move but with difficulty, and it would besides be exposed to birds and other enemies, therefore it comes to the surface chiefly during the night.

Q. But earth-worms are often found on the surface in damp weather, or after a shower, whether it be day or night?

A. They necessarily change their habitation with the changes of moisture in the earth. Where the ground is very dry and hard they cannot make their way, and where it is full of water they cannot breathe freely. In dry weather, therefore, they follow the moisture in their subterraneous journeys, and when rain comes they are found to make their escape by the surface.

Q. Is there any other means of bringing them to the surface?

A. Beating over the surface where they are, so as to shake the ground, sends them upward.

Q. How is that explained?

A. The greatest enemy that they have below ground is the mole, and the agitation that is produced by any motion on the surface has the same effect as if the mole were mining in their neighbourhood.

Q Are any of the other animals aware of that being the case?

A. When cattle go to a wet part of a meadow the birds that feed upon earth-worms are in the habit of resorting to the place, and alighting and pecking about among the cattle much more than they do when the cattle are on a dry place.

Q. What is the food of the earth-worm?

A. It is understood to eat the small fibres of roots and also the cotyledon leaves of plants, and it comes abroad regularly to graze during the night.

Q. Do they evince any degree of strength?

A. Very considerable. Their mere motion in the earth, which is comparatively rapid, and the hold which they take with their little spines, which when they are partially in the ground is so great that they can be pulled asunder more easily than pulled out, shew that they have considerable muscular power. The portion of their bodies too, which they can raise entirely from the ground, the rapidity with which they can twist them about, or lengthen and shorten them at pleasure, are also proofs of the same.

Q. Have we any instances of their being able to move substances?

A. We may often find leaves, rags, and bits of sticks, which far exceed themselves in weight, drawn into their holes, till even very stiff leaves be twisted together, or a long piece of the stick stands upright. The substances which they thus draw partially into their holes often require a considerable pull to draw them out again.

Q Are they of any use?

A. They disfigure the surface of lawns and walks, but it is probable that the perforations and bur ings which they make, admit manure to the roots of plants which would otherwise run off the surface and be lost. They are also the principal food of moles, hedgehogs, and many birds, and the numbers of them that are carried into the brooks and streams by every shower and flood, contribute greatly to the support of fish.

Q. How do they pass the winter ?

A. As the cold increases they plunge deeper and deeper into the earth, and probably remain torpid, but when the weather becomes warm they are easily roused again.

Q. How are they produced ?

A. From eggs which are laid in the ground, and every individual is both male and female.

Q. Have worms both ends the same, as they have no regular head ?

A. No. The mouth end is much more active than the tail. It can turn more easily in different directions, and it can push out in length by contracting its diameter, which the tail cannot so easily do. The tail is also a little flattened.

Q. But they can move tail foremost ?

A. They can, though not with so much ease in the direction of the tail, and they cannot sink into the ground tail foremost unless there be a hole previously made.

Q. Are there many species of them ?

A. The species are not easily ascertained, as difference of pasture produces great changes in their appearance. Large red worms, taken from rich loam d put into moss will diminish greatly in size and become much firmer, and if they be kept in a place inclining to marsh, they become of a yellowish and greenish colour.

Q. Are there any aquatic worms analogous to the dew-worm in their habits and general structure?

A. There is one; but the shape is conical, from the slenderness of the head, and it has two little hooks on the neck, probably to prevent it from being rolled about by the action of the water in the shallow places where it is found.

Q. What is the common name of those that have suckers?

A. They are generally called leeches, and most, if not all of them, suck the blood of animals.

Q. Where are they found?

A. They are lovers of moisture. Some are found in the sea; others in fresh water, chiefly where it is stagnant, and when the rains set in, the land in some of the tropical countries is perfectly infested with them.

Q. What are the characters of the sea leeches?

A. Many of them, especially in the warm latitudes, have not been observed, the one that is best known is *pontabdella spinulosa*, which is often taken out of the sea adhering to the bodies of skate, for which reason the fishermen call it the "scate-sucker."

Q. What is its appearance?

A. The body is cylindrical, and contracted toward both extremities, more especially toward the head; and it is but slightly contractile. It is surrounded by a number of prominent narrow hoops; and in the intervals between them, there are spines which range in regular rows in the length of the animals.

Q. Is there any thing peculiar about it?

A. Only that when bruised it discharges a dark liquor which stains a very beautiful purple; and might probably, if the proper attention were bestowed on it, be valuable in a dye.

Q. Why should that be supposed?

A. The only fine red and purple dyes that have been obtained either in ancient or in modern times, have come from small animals.

Q. Which are the fresh water leeches?

A. The horseleech is most common in this country, but the one that is most celebrated, or at least most valuable, is the bleeding leech.

Q. Where does it inhabit?

A. In slow running rivers and lakes, more abundantly perhaps in the lakes of Sweden than in those of any other country.

Q. What are its colours and size?

A. The colour is mottled, black, brown, and ash colour; but the size is not easily stated, as the animal can make itself of all shapes from a round ball to a slender thread. When it is in what we may consider a state of repose, it may be about two inches in length.

Q. Has it a sucker at each extremity?

A. It has an adhesive sucker at each extremity, but it sucks only with the mouth, and is understood to have no perforation the other way.

Q. How does it suck?

A. It adheres firmly by the sucker of the mouth, and makes a triangular perforation; but the manner in which it sucks is not so easily explained.

Q. Is not its action like that of a pump?

A. Its effect is something the same, and its action is said to be the same also, but that cannot very well be the case.

Q. Why not?

A. The action of a pump is by sucking out air, which is discharged into the atmosphere, and thus a vacuum is produced; but while a leech is adhering by the mouth we know of no part of its body by which air could escape.

Q. How does it act then?

A. Probably wholly by its muscles. It enlarges the cavity of its body, and by that means produces the vacuum.

Q. And does it act against a considerable pressure in that way?

A. The pressure against which it distends itself cannot be less than forty or fifty pounds' weight.

Q. Is its digestion rapid in proportion to the quantity that it sucks?

A. By no means. The leech is one of the most abstemious of animals; it can live for almost an indefinite period without food, and when it does suck, the blood will remain for months unaltered in at least some of the cells of its stomach. That stomach consists of twenty-four cells, and the back appears to have the power of so completely excluding the atmospheric air from those cells, that blood, which easily changes and putrifies, can remain long in them without alteration.

Q. How are the functions of life carried on in the leech?

A. Little is known about them, only that they must be very slow. Its organs of respiration have not been detected.

Q. But it does respire?

A. It must, for it cannot live without air.

Q. If it have no posterior opening, how is the waste part of its body removed?

A. It seems to be by a gradual casting of the skin in the form of little flakes.

Q. How are these found?

A. They are found in the water in which leeches are kept, or if one be kept some time in oil, it will cast an entire skin when put in water, which shews also that it does not respire by the skin.

Q. You mentioned that there are some countries in which leeches are an annoyance?

A. They are so in India, and especially in Ceylon. When the rainy season sets in, the whole surface of the moist ground swarms with them; they move with great rapidity; can stretch themselves out as slender as hairs, so that they can penetrate every where. They literally cover the bare legs of the people; and their bites are always painful, and often, under that hot climate, dangerous.

Q. Are they poisonous?

A. No. But the heat is so great, that they are apt to fester, mortify, and cause death.

Q. Are there any instances of danger from the bites of leeches in this country?

A. None from the natural bites even of the horseleech, which though in general one of the most abstemious of creatures, has become the very type of insatiable rapacity; but there have been instances of children being bled to death by the unskilful application of leeches to their temples.

Q. How are leeches produced?

A. They are said to be produced alive, and only one in the season; but that cannot be true of those species that multiply so fast.

Q. Which is the specimen of the flattened ones without suckers?

A. *Planaria.* They inhabit fresh water, have the mouth at the extremity, and two openings on the under side. They are very numerous, and distinguished by their eyes which are many, or four, or three, or two, or one, or none, according to the species. They are found in ditches and other stagnant fresh waters; and have the same resemblance to the molluscous slugs in their manners and motions, only they want the shield on the back, the foot on the under side, and have not the same anatomical structure.

Q. Which is a specimen of those that have bristles at the sides?

A. *Nais proboscidia,* which is flattened, and something in the shape of a boat. It is about an inch long, of a reddish colour, and partially transparent. The mouth is prolonged like a thread, and it is found hanging by that to the stems of aquatic plants in sandy and muddy rivers.

Q. Is there any thing curious about the mode of its production?

A. Yes, that is the most curious particular about it. The last ring of the body, without any apparent cause, enlarges, and is soon detached as a perfect animal; so that the creature absolutely grows like a plant.

Q. What are the characters of those annulose worms that have the organs of respiration apparent or external?

A. They vary in their characters so far as they are known, and the knowledge of them is not very perfect; but they admit of subdivision into two sections.

Q. How are those sections distinguished from each other?

A. First, those that have the body free, and secondly those that have it enclosed in a tube.

Q. Can you mention any of the former kind?

A. The curious genus *Nereis.*

Q. Why do you say the "curious" genus?

A. Because the nereides are really very singular animals. They are something in the shape of scolopendra, and therefore they are sometimes called sea centipedes; but they are in many instances so transparent that they are not observed in the water, till they be separated by a filter.

Q. There is nothing remarkable in that, there are many other transparent animals in the sea?

A. But these animals are as easily seen at night, as they are difficult to be seen during the day. In favourable states of the weather they appear on the tops of the waves like sparks, and dart from the oars of a boat like streams of fire.

Q. Have they all that property?

A. They probably have not; and at any rate their history is but imperfectly known, but many of them have it.

Q. What are they like?

A. They are long and slender, made up of a great many rings, with fin-like processes at the sides, and terminating in two bristles in the rear. Their mouths are furnished with jaws, and also appendages that may act as suckers, which last are various in the different species. In colours, the same species are often perfect cameleons, being sometimes pearly, at others green, again purple, and sometimes bronze colour, or black.

Q. Are there any of the same section without jaws?

A. There are, without jaws, and with distinct palpi.

Q. Are there many genera?

A. There are, and some of them are not very well defined; they are rather lengthened, with a coat of bristly appendages at the sides, covered with scales and sometimes with hair. One of the latter, *aphrodita aculeata*, is common in the British seas. It is oval, brown on the upper side, and reddish on the under, and known to the fishermen by the name of the "sea mouse."

Q. Are there any that have neither jaws nor palpi?

A. There are several, the *lumbricus marinus*, the *lob worm*, or *lug worm*, which the fishermen dig up with avidity, for bait, in many of the sandy and muddy shores, and which the older naturalists considered as a species of the common earth-worm belongs to this genus, and there is no doubt but the larger sand and mud worms, found within flood mark, that are eaten by the people of some countries, also belong to the same.

Q. And the worms that inhabit tubes?

A. Those tubes are either natural, or are constructed by the animal.

Q. What animal builds houses for itself in the sea?

A. Many animals can do that; but the one under consideration, (*trochilla lapidaria* of Linnæus,) constructs them with apparently fewer tools than most building animals, for it is a mere worm with only a bunch of *tentaculæ* round the mouth, and yet it contrives to make for itself a very strong and convenient moveable case, formed of sand and bits of shells; but by what means or what cement it unites them together, is not known.

Q. Of what seas is it an inhabitant?

A. Of the Mediterranean.

Q Are there any analogous animals found in the British seas?

A. There is a genus analogous in some respects, and which has been sometimes confounded with this, which is met with on the south coasts of Devonshire.

Q. What animal is that?

A. *Amphitrita volutacienis*, of which the tentaculas have the appearance of plumes of feathers, or the heads of some curious plant.

Q. Are these the whole of the names?

A. They are only one or two out of a great number; but even they shew that it is difficult to find out whether more ingenuity is displayed in those parts of nature that are the most complicated, or in those that are the most simple.

PART V.—CIRRHIPEDES.

Q. What sort of animals are these?

A. They are annulose animals, in which the body is covered with a shell of many valves or plates. From their form they are denominated *acorn shells*, and they were all included by Linnæus in a genus *lepas*, which means shells that stick to a rock.

Q. Where do they inhabit?

A. They are found only in the sea, and they always adhere to some other substance, as a rock, the bottom of a ship, floating wood, floating sea-weed, the shells of animals, and in short, any thing that will support them.

Q. And do they grow from a support like plants?

A. No, not like plants, for they strike no roots into that upon which they grow, and draw no nourishment from it.

Q. What is the meaning of cirrhipedes?

A. The literal meaning is "curled feet."

Q. And is that the character of the animals?

A. It is. The legs have a great number of appendages, and are often beset with hairs or bristles.

Q. How many legs have they?

A. The general number is twelve; of which the five pairs towards the front are much larger and more beset with appendages, than the others.

Q. Have they any head?

A. They have no head distinct from the body; and none of them have any organs that can be considered as eyes.

Q. Have they mouths?

A. They have; and these bear some resemblance to the mouths of some of the insects.

Q. Of what parts does it consist?

A. Of an upper lip, an under lip, formed by the union of the two external maxillæ, two mandibles, and two maxillæ, the latter having fleshy palpi.

Q. Does any other part of their structure resemble that of insects?

A. Their nervous system consists of a number of ganglions united by cords, as is the case with insects.

Q. Then are they less complete in their formation than insects?

A. In some particulars they are less, and in others they are more; their organs of sensation and motion are less perfect, but they have a heart and circulating system, which insects have not.

Q. Do they bear a resemblance to any other class of animals?

A. They resemble the mollusca in many particulars.*

Q. Which are those particulars?

A. They are of both sexes in the same individual, and they are produced from eggs.

Q. What are their organs of respiration?

A. A sort of gills attached to the bases of the legs.

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* See Catechism of *Mollusca*.

Q. On what do they subsist?

A. Nothing is known respecting their food.

Q. How are they divided?

A. Into two orders, *Campylosomata*, and *Acamptosomata.*

Q. What do those names mean?

A. The first means that the legs issue from a notch in the anterior part of the body, and thus are bent or erected to one side; and the other means that they issue from the extremity of the body, without any flexure to the other side.

ORDER I.—CAMPYLOSOMATA.

Q. What are the general characters of that order?

A. The base of the body is of a tendinous texture, and admits of being bent; the upper part is covered with plates of shell; and the legs pass out by a slit.

Q. Are there many genera?

A. Five are usually reckoned.

Q. What is the name, and what are the leading characters of the first genus?

A. A number of the genera were included in the genus *lepas* of Linnæus; but the name given to the first genus by more modern naturalists, is *Otion.*

Q. What are the characters?

A. The body is produced into a tendinous tube, composed of two coats; the inner one having muscular fibres, and containing cellular matter. The upper part of the body is composed of three coats, the external one covered with plates of shell. It adheres to rocks, to the bottoms of ships, and to other substances.

Q. How many species have been discovered?

A. Only one or two species are known, and but few specimens of them have been seen.

Q. Where have they been met with?

A. On the bottoms of ships that have landed on the southern coasts of England, after voyages of considerable length, but of which seas they are natives has not been satisfactorily ascertained; the probability is, that it is a native of the warmer seas.

Q. Which is the second genus?

A. *Cineras*, named from its colour. It has been met with very rarely, in nearly the same circumstances as the former.

Q. Is there any thing particular about these genera?

A. There are tubes of very singular form attached to the head, especially in the first genus, but the use of them is not known.

Q. Which is the third genus?

A. *Pentalasmis*, which imports that there are five scales, or plates of shell, on that which is considered as the head of the animal. In these the plates of shell completely cover the upper part; the lower shells nearly concealing the others, and giving the whole the shape of an acorn, and sometimes nearly that of the beak of a bird.

Q. Are the peduncles, or cartilaginous parts of the bodies of these long?

A. They are very long in some of the species, and very short in others.

Q. Is any common name given to them?

A. They are, in general, termed "barnacles," they often adhere in great numbers to the bottoms of ships that have been long at sea, and greatly impede their progress through the water; they also often adhere to pieces of timber and other floating substances.

Q. Have not some ridiculous stories been told of them?

A. Yes, it has been said that one of them, the *lepas anatifera* of Linnæus, the shells of which are very like the beak of a bird, changes to the gannet or solan goose, but of course the story is much too absurd for being believed by any person of sense.

Q. Have they no resemblance to those geese into which they were supposed to be changed?

A. Not the least, they are flexible tubes, generally of an irrisdescent or mother of pearl colour, with shelly points.

Q. What is the fourth genus?

A. *Scalpellum*, which has thirteen shelly scales on the body, the hinder one lancet-shaped, they are generally small.

Q. Where are they found?

A. In the Mediterranean, and also in the British seas, they generally adhere to corallines, and the cases of marine worms.

Q. What is the fifth genus?

A. *Pollicipes*, which has the upper part of the body with five large scales, and a number of smaller scales under them. The peduncle, although flexible, is covered with scales.

Q. Where are they found?

A. One species (*cornucopia*) is found in the north sea, and sometimes met with on the bottoms of ships returning from Norway. Other species are found in the Atlantic.

ORDER II.—ACAMPTOSOMATA.

Q. How does that order differ from the former ?

A. In being without a cartilaginous peduncle or stalk; in having the whole body inclosed in shells of a greater or smaller number of pieces, and in having the legs protruding from the centre of the operculum,* which closes the upper orifice.

Q. Are there any general divisions of the order ?

A. There are two : those that have the operculum fleshy, and those that have it of shell.

Q. Are there many genera ?

A. Nine have been observed : three with the *fleshy* operculum, and six with the shelly or testaceous one.

Q. Where are those with the fleshy operculum found ?

A. Chiefly upon the bodies of whales and turtles.

Q. Do they feed upon those animals ?

A. Nothing is known of their manner of feeding ; and it is probable that they adhere to the bodies of animals only for support.

Q. What is the first genus ?

A. *Tubicinella*, which is a very singular-looking creature, not unlike a small bottle packed in a basket.

Q. What part resembles the basket ?

A. The outside shell, which is nearly cylindrical, but rather narrowest at the base. It is marked with rings, and also with upright bands.

Q. How is it closed at top ?

A. With four plates of shell, which surround and support the operculum; and the opening of that rising above the shell, is not unlike the mouth of a bottle.

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* For an explanation of operculum, see Catechism of Mollusca.

Q. What is the second genus?

A. *Coronula*, which has the shell much wider at the base than at the top, and the operculum and shelly notches bearing some imaginary resemblance to a little coronet or crown, whence its name.

Q. Which is the third genus?

A. *Chelonobia*, which has the shell much flattened, and the operculum defended by four large scales equally formed.

Q. Where does it inhabit?

A. Both it and the former genus are found on turtles.

Q. Which is the first genus with the shelly operculum?

A. *Pyrgoma*. It is found on the harder species of coral, with the base of the shell partly imbedded in the substance of the coral. It is not unlike a very small limpet, having the opening covered by other two minute shells.

Q. Are there many species?

A. There are two or three, found only in the warm seas where corals are abundant.

Q. Which is the second genus?

A. *Creusia*, which has the shell divided into four parts. The upper parts of the shells are formed into ribs, and have spines upon them. The genus, which consists of very small animals, is found upon corals.

Q. Which is the third genus?

A. *Acasta*. It is a singular minute animal. The bottom part of the shell is a little cup, to wh longer and two shorter scales of shell are attached, pointed at top, covered with spines, and bearing some resemblance to the petals of a flower.

Q. Where are they found?

A. Chiefly upon sponges.

Q. Is there any common character in those genera with shelly operculi which you have mentioned?

A. Yes, the bases of them have a definite form, independently of the substances to which they are attached; whereas in the remaining genera, the base always takes its form from the substance on which it happens to grow.

Q. Are there many of those genera?

A. Three are established. They are the *balani*, or acorn-shells of the elder authors.

Q. Which is the first genus?

A. *Balanus*. The shell is compressed and much furrowed. It consists of six parts; and both valves of the operculum are divided in the middle.

Q. Which is the second genus?

A. *Conia*, in which there are only four divisions in the shell, the surface of which is honeycombed.

Q. Which is the third genus?

A. *Clisia*, which has the shell in four parts, and the valves of the operculum undivided.

Q. Why are these called acorn-shells?

A. The outer part of the shell bears some resemblance to the capsule on the bottom of the acorn, and the scales of the valves some resemblance to the nut.

Q. Are those animals abundant?

A. They are, especially the genus *clisia*. They are found upon most marine substances; on stones, on sea-weed, on the shells of the mollusca, and the crusts of the crustacea. They grow even above high water-mark on rocks which are much wetted by the spray.

Q. When you speak of the legs and feet of those animals, you do not mean that they are organs of motion?

A. Certainly not. Their use is not known; but it is probable that by agitating the water and producing currents, they entangle and bring to the mouth of the animal the minute substances on which it feeds.

Q. Do the cirrhipedes multiply fast?

A. They do with amazing rapidity, more so, perhaps, than any other class of animals with which we are acquainted.

Q. What is the form of their eggs?

A. The individual eggs are very minute, and formed into spongy masses, which float easily on the water, and as easily attach themselves to other substances. Cases have been mentioned in which two generations have been produced upon a feather before that begun to decay; and a very few months, in the seas where they are abundant, suffices for covering the bottom of a ship with them.

Q. Are they of any use?

A. Some of the species have been used as food, and in taste and other qualities they do not appear to differ much from the shelled molluscá.

Q. Are those that are produced always separate animals?

A. That part of the subject is not very well understood. Some of the pedunculated ones have the peduncles branched, forming two or more separate shelly heads from the same base; but whether all the branches are formed at the same time, or the one grows as a sprout from the other, has not been ascertained.

PART VI.—RADIATA.

Q. What are the distinguishing characters of the radiated animals?

A. They have the nervous system diffused through the whole mass of their bodies, without any collar round the gullet, or any longitudinal cord connecting the ganglions, and their bodies are not divided into rings.

Q. Are they without bones?

A. They are, in all the species.

Q. What is their general form?

A. They have always more or less of the form of a star.

Q. Have they organs of sensation?

A. Neither eyes nor ears of any description have been found in any of them.

Q. Where do they inhabit?

A. The whole of them are inhabitants of the water, some of them being fixed and others floating.

Q. Are they numerous?

A. They are remarkably so. Some seas are absolutely filled with them; they are found more or less in all seas, and are supposed to form the principal food of the *balænæ*, or whalebone whales, whose mouths and throats are adapted only for food in small portions.

Q. What are their common names?

A. They are called sea-eggs, star-fish, sea-blubber, and sea-cuçumbers, according to their form, but those names do not serve as any indication of their nature.

Q. What is the classification of them?

A. As many of them reside at the bottom of the sea in deep water, their history is far from perfect, but there are four classes which are tolerably well made out.

Q. What are these?

A. *Echinodermata*, *Acephala*, *Zoophyta*, and *Infusoria*.

I. ECHINODERMATA.

Q. What is the meaning of *echinodermata*?

A. Having the skin or covering beset with points or spines resembling those on a hedge-hog.

Q. What are their characters?

A. The covering is either a leather-like skin or a crust; they have a distinct stomach or intestine, and numerous vessels; but some of the characters are so different that the class admits of division into two orders, those that have the intestine open at both extremities, and those that have it open only at the mouth.

Q. Do these admit of any subdivision but those of genera and species?

A. They do, into those that have organs of motion and those that have not.

Q. What are the organs of motion?

A. They are suckers of some form or other.

Q How many divisions have suckers?

A. There are two principal divisions; which contain many species: those with a crustaceous covering, and those with a leather-like skin.

Q. What is the name of the first of these?

A. *Echinida*, sea hedge-hogs, or sea-eggs.

Q. What is their general shape?

A. It is not unlike that of a turnip, it is covered with a plate beset with spines or thorns, between which there are holes having suckers with shelly stalks attached to them. The spines are also moveable by means of strong ligaments that attach them to the crust, and probably they are organs of motion as well as the suckers.

Q. Where is the mouth situated?

A. Generally in the under surface of the shell, and it is in many of the species armed both with tentacula and teeth.

Q. Are they numerous?

A. They are. More than a hundred species are known. They are found in all the oceans and the shells are often washed on the shores of the British islands, especially those toward the Atlantic.

Q. Are they large?

A. They are often several inches in diameter.

Q. Are they ever used for food?

A. Some of the savage tribes on the southwest coast of South America, and in other parts of the world, are said to live entirely upon them at certain seasons.

Q. How are they obtained?

A. By diving under water.

Q. Which is the division which has the covering leather-like?

A. It is chiefly made up of the Linnæan genus *Holothuria*, or sea-slugs.

Q. What are their characters?

A. The body is lengthened, and has a moveable leathery covering, and the mouth is surrounded by tentacula, and also by a circle of sharp plates that answer all the purposes of teeth.

Q. Are there many species of them?

A. A good many are known. They are most abundant in the warm seas, and in some places they and the former division almost cover the bottom.

Q. Are they ever used as food?

A. One or two species found in great numbers on the north coast of New Holland and among the adjoining isles, are extensively fished for by the Malays.

Q. To what use do those people apply them?

A. They spread them out and dry them, after which they are sold to the Chinese by the name of Trepang. They are said to make an excellent soup.

Q. Which are they that have only one opening to the stomach and suckers for motion?

A. They are the *stellerida*, or star-shaped animals, of which there are many species, some of them by no means uncommon on the British shores. They have the mouth on the under side; the stomach a simple bag; some traces of a nervous system, but no organs of the senses that have been discovered.

Q. Which are they that have no suckers for locomotion?

A. The *Crinoidea*, which have the rays of the star lengthened out into long thread-like arms. Only one living species, (*Pentacrinus Caput Medusæ*,) is known. It has, as the name imports, five arms; and those arms curl round it, as the snakes are said in the fable to have done round the head of Medusa. The body, opposite to the mouth is lengthened into a jointed stalk, by which the animal probably adheres to other substances.

II. ACEPHALA.

Q. What is the meaning of *Acephala*?

A. It means without a head.

Q. What animals are comprehended in that order?

A. The *Actinia* of Linnæus, which from their form are sometimes called animal flowers; and the *Medusa* of the same naturalist, which, from their effects on the skin, are sometimes called sea-nettles.

Q. What are the general characters of the *Actinia*?

A. They are very soft, adhering to other substances, in the form of a little purse or bag which can be shortened or lengthened at the pleasure of the animal. The mouth is an opening in the top, surrounded with tentacula, which when spread out as the animal watches for its prey have something the appearance of a flower, and they are often very beautifully coloured, on which account they are called, sea-anemonies, sea-tulips, and various other fanciful names.

Q. On what do they live?

A. One part of their food is shelled mollusca; for if a perriwinkle be laid on the centre of the tentacula, these will come close upon it; it will be carried into the cavity; and the operculum and empty shell soon afterwards thrown out.

Q. Are they all fixed to the spot?

A. No. Two of the modern subdivisions of the genus, the *actinia* properly so called, and the *lucernaria*, adhere by a sort of foot or sucker, and can move; but another division, the *Zoanthus*, or animal flower, properly so named, remains permanently on the same spot.

Q. Are any of them found on the British shores?

A. The actinia are very common on the rocky and stony shores; there are at least eight species on the different parts of the coast.

Q. Are there many British species of Lucernaria?

A. Only two have been observed; and these have been found adhering to sea-weed.

Q. Are there any British species of Zoanthus?

A. There is one, *mammaria mamilla*, white and of a conical form, without tentacula at the mouth.

Q. Are the animals of this order of any use?

A. They are not attended to as they perhaps ought to be; but some of them have been eaten, they are wholesome and of very fine flavour.

Q. Do the Medusa resemble the actinia in any respect?

A. They have but little resemblance. The Medusa float on the water; and, along with the other soft floating animals, are supposed to serve for food to the whales.

Q. What is their form?

A. They consist of a mass of jelly, often colourless, to which a number of tentacula or arms are attached; and they are sometimes of the most singular shapes.

Q. Do any of them shine in the dark?

A. Very many of those that are transparent and colourless, and of course invisible during the day, shine with considerable brightness during the night.

Q. Are they eaten by man?

A. When they are in their live state, there is scarcely any thing to eat. The greater portion is of a consistence more like drink. But no person would choose them for that purpose.

Q. Is there any thing poisonous about them?

A. Nothing probably which is absolutely poisonous; but the juice of the larger ones especially is so acrid that it excoriates, and in some cases blisters the skin.

Q. Are there many species of those animals in the British seas?

A. There are a great many, but they are a little confused, as the specimens soon change after they are out of the water; and as some of them are very different in form when young from what they are when full grown, it is by no means impossible that the same species may have, at different stages of its growth, been described as different species.

Q. Are there any remarkable differences of character among the animals of this class?

A. There are. Some have neither mouth nor cavity within, some have both of these without any other opening, while some have the lateral openings also, and others again those openings without the mouth. The mouth is sometimes close upon the mass of the body; at other times it is drawn out into a sort of proboscis which is sometimes plain at the extremity, and sometimes divided into tentacula fringes. The body is also sometimes smooth, and at other times marked with ridges, and those ridges are beset with hairs that answer nearly the same purposes as fins in swimming.

III. ZOOPHYTES.

Q. What is the meaning of *Zoophytes?*

A. The term literally means animal plants, or animated plants; and was probably given at first in all cases where it appeared doubtful whether the object named ought properly to be considered a plant or an animal.

Q Have they any resemblance to the acephala?

A. They have; but still the two may be distinguished.

Q. What are the chief distinctions?

A. The zoophytes are distinguished from the first order of acephala, by having only one set of tantacula round the mouth, while these have two rows.

Q. Is not there a portion of the first order with which some of the zoophyta are apt to be confounded?

A. Yes; with zoanthus, as that has no tentacula at the mouth.

Q. How are they distinguished from the second order of acephala?

A. The second order of acephala have no t which the zoophytes have; and the zoophytes have tendency to become compound, which the others ha not.

· Q. Are the zoophytes made up of different parts t which names can be given?

A. Yes, they are made up of two parts, which ar called the *polypus* and the *coral.*

Q. What is meant by the polypus?

A. That part of the compound structure which may be considered as exhibiting the head and body of the animal, with the mouth and tentacula.

Q. What is the coral?

A. The part which supports the polypus.

Q. Of what substances are these formed?

A. The polypus is always, in the greater part of its texture, a fleshy substance; the coral is, in some instances fleshy, in others it is made up of membranes; in some it is of the consistency of a crust, and in others again it is of the consistency of the hardest shell.

Q. Is the coral always an animal structure?

A. It is, even in the hardest of them, which are as hard as most rocks, and more tough; the matter by which the salts of lime and other parts of the compound are held together, are always of an animal nature.

Q. How may that be known?

A. When sponge or coral is burnt, it does not smell like vegetable or earthy matter, but like bones or shells.

Q. Has the polypus been seen in all cases as distinct from the coral?

A. Not in all cases; the polypus of the sponge has not been observed; and the same may be said of many of the coral lines.

Q. What are the divisions of the zoophytes?

A. They are divided into four orders.

Q. What are the characters of the first order?

A. The polypus is connected with a fleshy coral, supported by a loose bony mass in part of the order, and by a fleshy or fibrous mass in the other. The animals have a stomach and mouth, with eight tentacula. Some of them float freely on the water, and others are fixed; the former being those that have the coral supported by bone.

Q. Are there many genera of these?

A. There are a great many, and they are very different in their characters,

Q. What are the characters of the second order?

A. The polypi are much more simple in their structure, and they have more tentacula than eight, but the number varies even in the same species.

Q. Are the different polypi in any of these connected with each other?

A. In general they are not; the cells in which they are contained being closed at the bottom.

Q. What are the characters of the third order?

A. They have a leather-like covering; the species hitherto discovered are not numerous.

Q. What are the characters of the fourth order?

A. The animals have hairs at the mouth, which they can put into rapid motion, and occasion currents in the water. They are so small that they cannot be studied without the aid of a microscope.

Q. Which are the particular divisions of zoophites ?

A. There are at least four tribes, and most of these contain many families, with a vast number of genera, species and individuals.

Q. Which is the first tribe ?

A. *Carnosa*, in which the substance that connects the polypi is fleshy.

Q. What are the principal families in that tribe ?

A. Those which are free to move, and those that are fixed.

Q. Are there any British ones ?

A. Yes. Of those that are free, there are two, not uncommon on the shores of Scotland.

Q. What are these ?

A. The sea-pen and the sea-rush.

Q. What is the character of the sea-pen ?

A. The stem of the coral is about five or six inches long, and nearly round; the upper part is flat, and consists of processes, which are arranged something like the web of a feather. It is on that account that it is called the sea-pen.

Q. What is its colour ?

A. Purple.

Q. Is it one animal, or many animals ?

A. It is many animals; and the cells which these inhabit are at the extremities of the processes.

Q. Is the whole formed of soft matter ?

A. No; there is a bone in the centre of the stalk.

Q. What are the characters of the sea-rush ?

A. It is longer and more slender than the pen;

and the lobes to which the cells with the polypi are attached, have the form of a crest.

Q. Are the fixed ones more numerous than the free?

A. They are; and they are found in the fossile substances of many of the softer rocks.

Q. Which are the most remarkable British ones?

A. They are gorgons, corallines, and sponges.

Q. What is the principal British species of gorgon?

A. There is not any British species. The whole are natives of the deep seas; and though some specimens have been cast ashore, none has been found growing in Britain.

Q. What are the forms of those that have been cast ashore?

A. They are all more or less fan-shaped.

Q. Do the corallines also inhabit the depths of the ocean?

A. No; the British species are mostly found in shallow water.

Q. What is their shape?

A. They are plant-like, and contain animal matter in the centre, and a crust or bark of lime. The polypi of them are very obscure.

Q. Are they numerous?

A. They are found on most parts of the coast.

Q. Are the sponges numerous?

A. They are very numerous, and are found in fresh water as well as in the sea.

Q. What substance does the common sponge, which is used for so many domestic purposes, most nearly resemble?

A. Probably horn, though the horny particles are very minute; but there are some that contain a considerable portion of flint.

Q. How is it known that a sponge is alive?

A. By its giving out water by pores on the surface, after that water has circulated through the tubes of the mass.

Q. Do sponges change soon after death?

A. They do. The jelly which lines all the cavities in them speedily dissolves in the water, and nothing remains but the skeleton.

Q. What are the characters of the second tribe of zoophytes?

A. The polypi are lodged in cells, consisting in great part of lime, and hence they are called *cellulifera*, or cell-bearing.

Q. Are the British species numerous?

A. They are. Some are stiff and hard, and others are flexible. Some have a faint resemblance in their appearance to sponges; some are bundles of little pipes; and some are flat like leaves.

Q. What is the third tribe?

A. *Thecata*, or those that are contained in sheaths.

Q. Of what are the sheaths composed?

A. Some of them contain a small portion of lime, and others are wholly soft matter.

Q. Are they numerous on the British shores?

A. They are; where they grow adhering to stones, corallines, and other solid substances.

Q. Which is the fourth tribe?

A. *Nuda*, or those that have the polypi naked, or with sheaths so short that they are not easily distinguished.

Q. Are they fixed or free to move?

A. Some are fixed and some are free.

Q. Where do they inhabit?

A Some are inhabitants of the sea and others of fresh water. They are soft in the consistency, and bear a resemblance to some of the radiata.

Q. What are their dimensions?

A. Seldom more than half an inch in length, except in one or two of the species.

Q. Is this part of the natural history of animals as well defined as that of the more perfect classes, as they are called?

A. By no means. As we approach the confines of the animal kingdom, the organs of the senses and the power of motion are both lost; and we infer rather than perceive that the beings themselves are possessed of sensation.

Q. And is it for that reason that we call those less perfect animals than the others?

A. The imperfection is not in the animals, but in our knowledge of them. They are all equally perfect in their kinds; and that an animal should find its food and perform all its functions without any of those organs which we find in other animals, is just as convincing a proof of the power of the Creator, as any that we can find in those portions which we are accustomed to call the most perfect.

IV.—INFUSORIA.

Q. What are the *Infusoria?*

A. They are the most simple of all animals, consisting of little more than a skin.

Q. Is there any thing peculiar in the way in which they are produced?

A. If there be a live animal, others appear to be producible from it in almost every way, as by eggs, by buds, and by the division of the animal itself into parts.

Q. Are they large or small animals?

A. They are remarkably small, and very few of them can be examined without a microscope.

Q. Are there any distinctions of organization among them?

A. Yes; there are two orders, in the one of which there are some appendages to the skin, such as hairs; and in the other there is nothing but the skin itself.

Q. But still, notwithstanding all the complexity of their forms, they may be considered as animals?

A. There can be no doubt of that. Though an animal be as simple as a mere bag of skin of so small size as not to be seen, there is no danger of confound- it with a vegetable.

Q. Is any other name given to the Infusoria?

A. They are sometimes called *animalcules.*

Q. Why are they called animalcules?

A. It is the name for very small animals.

Q. Why are they called Infusoria?

A. Because they chiefly make their appearance in infusions of animal and vegetable substances.

Q. Are they numerous?

A. They are perhaps the most numerous of all animals.

Q. From what are they produced?

A. The germs of them appear to be distributed every where.

Q. Are those germs ever seen?

A. They are too minute for being observed separately.

Q. Since they are so very small, are they not in danger of being destroyed?

A. They are far less easily injured than larger animals. They breed in infusions that have been boiled, and the very small ones are produced in an infusion that is boiling; so that from them, one is led to conclude, that the smaller any living creature is, it is the less liable to destruction.

Q. At what time are they formed?

A. The infusion must have begun to putrify.

Q. Is it necessary that the infusion should be an artificial one?

A. No; it is only necessary that it shall have begun to putrify.

Q. Are they found in the juices of plants and animals?

A. That the germs of them are, there is no doubt, but it is probable that putrefaction or disease of some kind or other, always must be begun, before they quicken into life.

Q. Do they breathe?

A. There is every reason to suppose that they do.

Q. What are some of the reasons?

A. They appear most abundantly in infusions which are freely exposed to the air, and when the air i wholly excluded, they die.

Q. Do they always die when the infusion in which they are contained is dried up?

A. They do not; they shrivel, become dry, and dead; in which state they may be kept for years, at the end of which they will revive if moistened.

Q. Is there any limit to their smallness?

A. There appears to be none, but the power of the microscope by which they are discovered.

Q. Then there may be living creatures, dozens of which would not equal a pin's head?

A. There may be those of which a flock of a million, or a hundred millions, would not be visible.

Q. What is the conclusion?

A. That while we study NATURE, we should strive to obey the laws of NATURE'S GOD.

END OF THE CATECHISM OF ZOOLOGY.

LONDON:
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